INSTALLATION RESTORATION PROGRAM

PHASE 1

RECORDS SEARCH

SELFRIDGE AIR NATIONAL GUARD BASE, MICHIGAN

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AIR NATIONAL GUARD

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PREPARED FOR
SELFRIDGE AIR NATIONAL GUARD BASE
MOUNT CLEMENS, MICHIGAN
APRIL, 1983

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INSTALLATION RESTORATION PROGRAM
PHASE I: RECORDS SEARCH
SELFRIDGE AIR NATIONAL GUARD BASE
MT. CLEMENS, MICHIGAN

Prepared for

Detachment 1, Headquarters Michigan Air National Guard

Selfridge ANG Base, Michigan

By

ENVIRONMENTAL CONTROL TECHNOLOGY CORPORATION
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with

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Rochester, Michigan

and

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Williamston, Michigan

April, 1983

DAHA20-82-C-6065

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EXECUTIVE SUMMARY

The Department of Defense (DOD) has developed a program to identify and evaluate past hazardous material sites on DOD property, to control the migration of hazardous contaminants, and to control hazards to health or welfare that may result from these past disposal operations. This program is called the Installation Restoration Program (IRP). The IRP has four phases consisting of Phase I, Initial Assessment/Records Search; Phase II, Problem Confirmation; Phase III, Technology Base Development; and Phase IV, Operations. Environmental Control Technology Corporation was retained by the Michigan Air National Guard to conduct the Phase I, Initial Assessment/Records Search, at Selfridge Air National Guard Base under Contract No. DAHA 20-82-C-6065.

INSTALLATION DESCRIPTION

Selfridge ANGB is located near Mt. Clemens, Michigan. Selfridge was activated in 1922 and has operated under Army, Air Force, and Air National Guard command. The primary mission of the base is to train Air National Guard personnel.

ENVIRONMENTAL SETTING

The environmental setting data reviewed for this study indicate the following key items concerning the impact of past waste disposal practices on the base:

- Selfridge ANGB is underlain by extensive clay layers, with occassional sandy intervals at lower depths.
- Surficial soils are primarily clay soils or fill material.
- Groundwater resources in the area provide only marginal sources of water supplies.
- No rare or endangered species of plants or wildlife are found at Selfridge ANGB.
- Precipitation is about 28 inches per year and annual evaporation and transpiration is approximately the same.

METHODOLOGY

During the course of this project, interviews were conducted with those past and present base personnel familiar with past waste disposal practices. File searches were performed for facilities which have generated, handled, transported, and disposed of waste materials. Interviews were held with local, state, and federal agencies, and site

inspections were conducted at facilities that have generated, treated, stored, and disposed of hazardous waste. Seven disposal sites located on Selfridge ANGB property were identified as containing hazardous waste resulting from past waste disposal activities or significant fuel spills. These sites have been assessed using a hazard assessment rating methodology (HARM), which takes into account factors such as site characteristics, waste characteristics, potential for contaminant migration, and waste management practices. The details of the rating procedure are presented in Appendix E and the results of the assessment are given in Table ES-1. The rating system is designed to indicate the relative need for follow-on action.

FINDINGS AND CONCLUSIONS

The following conclusions have been developed based on the results of the project team's field inspection, review of base records and files, and interviews with base personnel.

Seven sites were determined to have a moderate potential for migration of contaminants. These are as follows:

- Southwest Landfill
- Fire Training Area No. 2
- Fire Training Area No. 1
- West Ramp Fuel Spill
- Northwest Landfill
- East Ramp Fuel Spill
- Tucker Creek Landfill

Two sites were determined to have a low potential for contaminant migration. These are as follows:

- Sludge Application Area
- Perimeter Road

TABLE ES.1

HARM Ranking of Sites
Selfridge ANG Base

Rank	Site Name	HARM S
1	Southwest Landfill	74.7
2	Fire Training Area-2	71.8
3	Fire Training Area-1	70.5
4	West Ramp Fuel Spill	66.4
5	Northwest Landfill	64.9
6	East Ramp Fuel Spill	60.7
7	Tucker Creek Lanfill	59.4

RECOMMENDATIONS

The detailed recommendations developed for further assessment of potential contaminant migration are presented in Chapter V. These recommendations include, in general, obtaining soil borings in and around each of the rated sites, and analyzing the samples to determine the level and type of contamination.

1.0 GENERAL

1.1 PURPOSE OF THE RECORDS SEARCH

The records search and personnel interviews reported herein were performed in order to assess the potential for hazardous material contamination at Selfridge Air National Guard Base (SANGB) as a result of past waste disposal practices. In addition, the potential for contamination to have migrated beyond the base boundaries was assessed.

1.2 AUTHORITY

The program was carried out in response to Federal law - Resource Conservation and Recovery Act (RCRA) and Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as implemented by Executive Order 12316, Department of Defense Environmental Quality Program Memorandum 81-5, and instructions from the Air Directorate of the National Guard Bureau of the Departments of the Army and the Air Force.

1.3 INTRODUCTION

The Search and Assessment Team was composed of representatives of three firms - Environmental Control Technology Corporation (ENCOTEC) represented by Craig Morgan, Environmental Consultants Incorporated represented by Katherine Everett, and Keck Consulting represented by Joseph Sheehan. Project Management was provided by John Schenk of ENCOTEC.

The Notice to Proceed was received on 1 June 1982, with the project schedule being submitted for approval on 16 June 1982. Interviews were conducted on various dates during the months of July and August, with a thorough review of all available files made during the same period. In addition to the interviews and files search, a comprehensive evaluation of historical aerial imagery was made during the July-August period by Dr. Charles Olsen of the University of Michigan.

1.4 INSTALLATION HISTORY

The history of Selfridge Field began with the

leasing of 640 acres of farmland in 1917 by the U.S. Army. By 1922, the initial base land area was purchased, establishing the facility as a permanent installation. Considerable expansion occurred during World War II, with the base now encompassing over 3600 acres. The base remained under the administration of the Army until the U.S. Air Force was established as a separate service in 1947, at which time it became an Air Force installation. Finally, in 1971 the facility was transferred to the Michigan Air National Guard, who currently maintain authority over its operation. See Figures 1.1-1.3 for areal maps.

1.5 ENVIRONMENTAL SETTING

1.5.1 METEOROLOGICAL DATA

Climate

The major climatic control in the area is latitude which determines the amount of solar insolation received and results in prevailing westerly winds. These effects are modified somewhat by Michigan's location relative to the Great Lakes in general and the site's proximity to Lake St. Clair in particular.

Although prevailing winds are westerly, the predominant wind direction in the summer months is southwesterly as the Bermuda High Pressure Center pushes into the southeastern United States. The prevailing wind direction shifts to westerly to northwesterly in the winter months but all patterns are subject to frequent and considerable variation as migrating cyclones and anti-cyclones move through the Midwest. The 1981 windrose for the Detroit City Airport (approximately 25 kilometers from Selfridge ANGB) is shown in Figure 1.4.

The climate is classed as humid continential to semi-marine and is dominated by continental polar air masses in the winter and tropical air masses in the summer. The interaction of these air masses along cold fronts associated with east-moving cyclones results in strong seasonal temperature contrasts, highly changeable weather, and ample precipitation throughout the year.

FIGURE 1.1 Regional Location Map

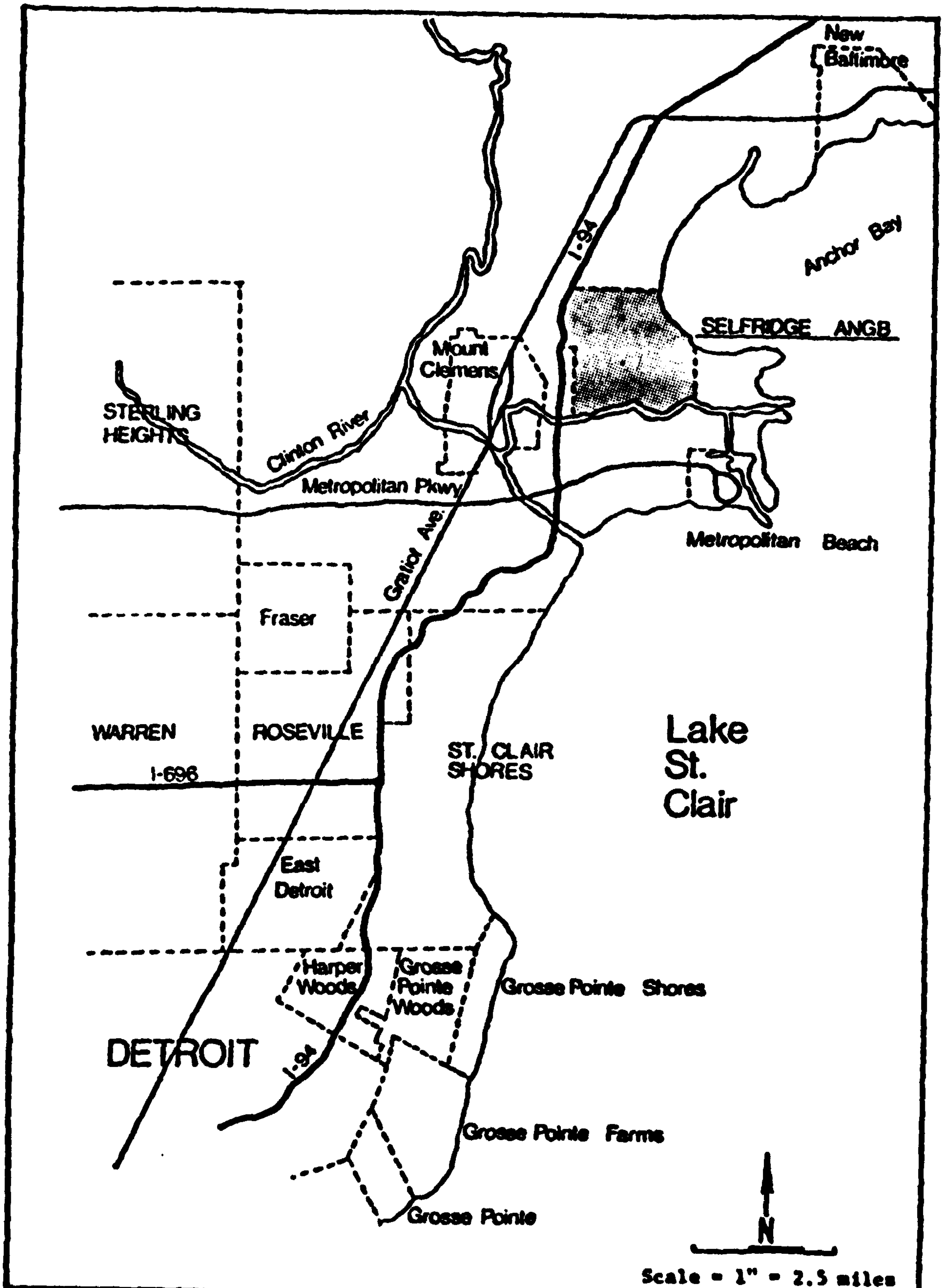


FIGURE 1.2 Area Location Map

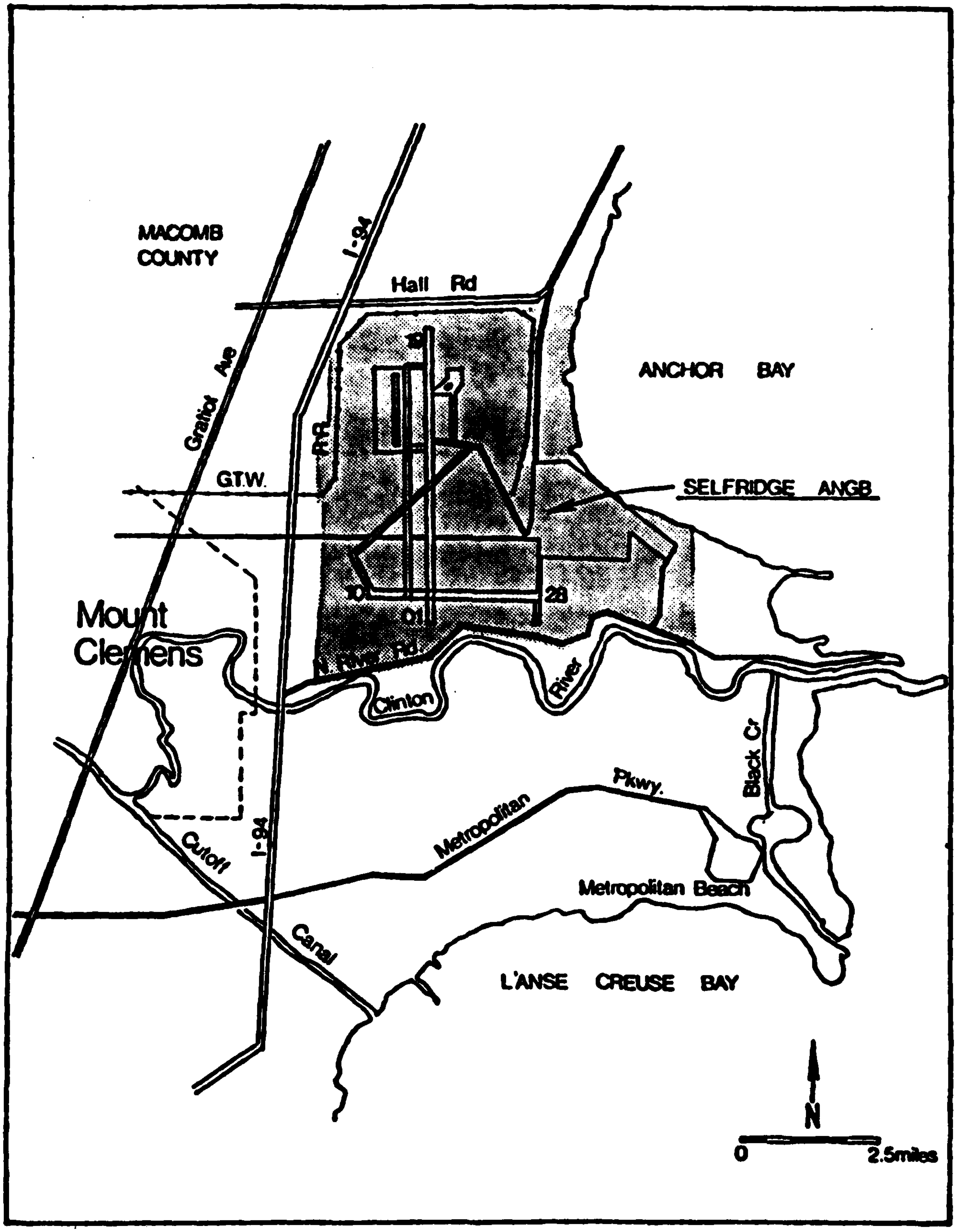
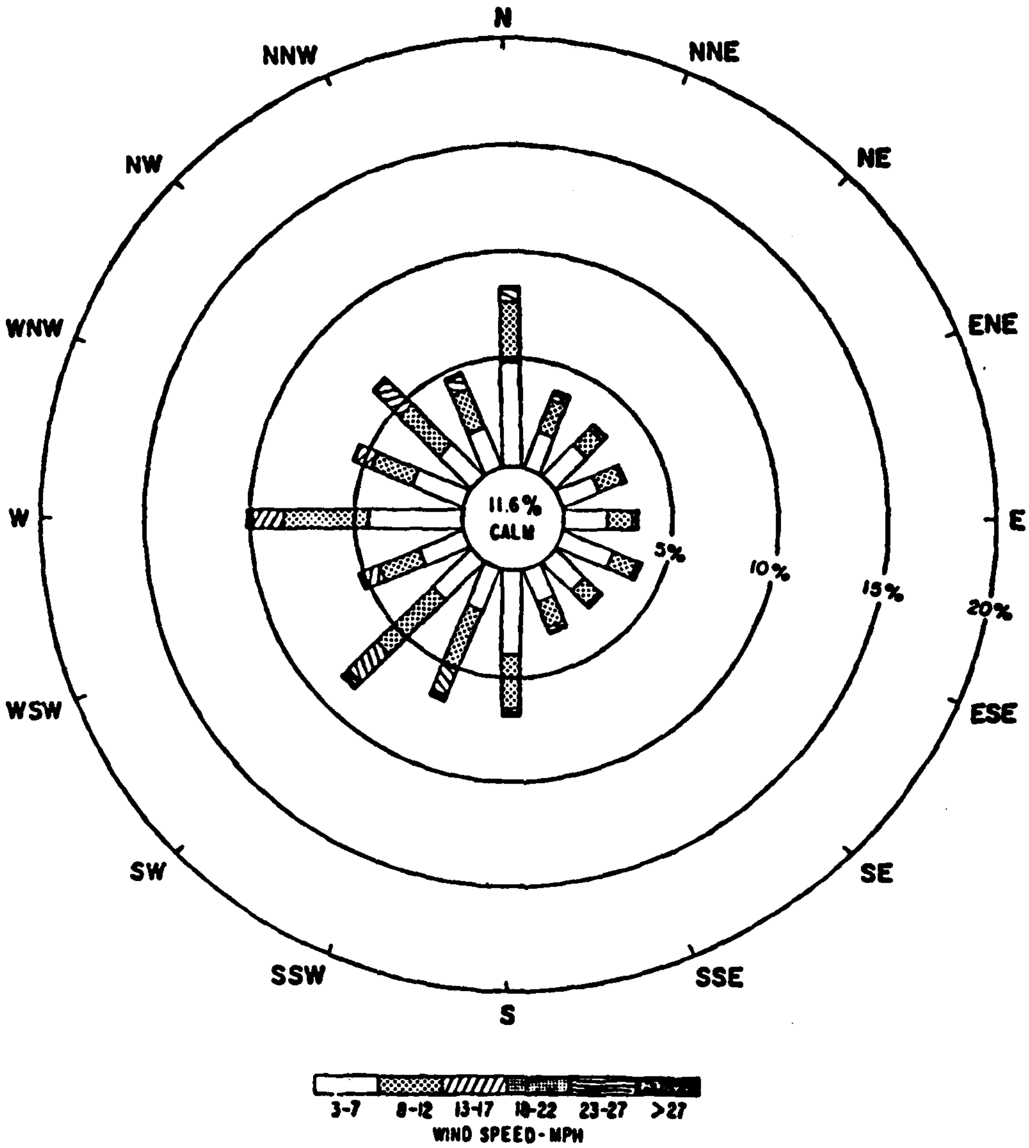


FIGURE 1.3 Site Map

Figure 1.4



DETROIT CITY AIRPORT
DETROIT
1981

Table 1.1

Climatological Summary
Mt. Clemens, Michigan

Average Temperature (°F)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ann'l
1940	18.5	24.7	27.6	41.4	54.2	66.3	72.3	69.9	61.6	51.6	37.3	30.4	46.3
1941	25.7	24.3	29.5	51.4	60.6	68.8	73.0	69.5	65.8	54.0	41.4	34.4	49.9
1942	24.8	22.2	37.6	51.2	58.0	67.6	72.6	70.2	61.5	52.2	40.0	24.9	48.6
1943	20.6	26.5	32.4	41.2	54.5	71.6	72.8	71.1	60.6	49.6	37.5	26.7	47.1
1944	28.9	27.0	31.0	42.2	62.1	69.9	72.2	73.3	64.5	51.5	41.2	23.4	48.9
1945	17.0	26.5	45.5	48.2	51.6	64.1	70.1	70.5	63.5	49.2	40.4	23.6	47.5
1946	25.7	25.1	44.3	46.7	55.4	66.6	72.2	67.5	64.1	56.9	42.9	31.0	49.9
1957	27.5	21.5	30.1	44.1	53.2	65.3	70.5	75.6	65.1	59.9	37.3	27.4	48.1
1948	18.6	23.1	33.0	49.8	54.6	66.4	72.7	71.0	63.7	49.7	44.6	30.5	48.1
1949	30.7	30.1	34.8	46.3	60.1	72.4	75.3	71.6	59.2	56.5	38.2	31.7	50.6
1950	31.4	25.3	29.0	40.9	57.1	67.3	70.1	68.7	61.8	55.7	36.1	24.5	47.3
1951	26.7	26.4	34.9	44.9	58.2	66.1	71.4	68.0	61.3	53.9	33.7	26.9	47.7
1952	27.6	28.5	33.3	48.4	56.5	71.9	75.7	70.3	63.2	47.3	41.4	33.3	49.8
1953	29.5	30.8	36.8	44.1	58.6	70.1	73.4	73.2	63.8	55.6	43.5	32.9	51.0
1954	24.3	32.2	33.0	40.6	54.4	70.3	70.6	69.7	64.3	53.6	40.5	28.8	49.2
1955	25.6	27.0	34.3	53.3	61.4	67.6	78.7	75.4	65.0	54.3	37.8	26.7	50.6
1956	25.8	26.7	31.5	44.2	55.5	68.9	71.1	70.8	59.5	56.6	40.0	34.0	48.7
1957	19.5	28.2	35.2	47.1	55.4	68.1	72.3	69.8	62.9	50.9	40.8	33.4	48.6
1958	26.8	22.2	35.9	48.2	57.2	63.1	72.5	70.1	62.9	54.2	41.8	20.9	48.0
1959	20.1	24.6	32.7	47.4	60.8	68.7	72.9	75.1	66.1	51.0	35.7	33.5	49.1
1960	27.1	26.4	24.7	47.9	57.5	66.3	70.1	71.2	65.3	52.4	42.4	23.8	47.9
1961	21.5	29.2	37.5	42.2	54.4	66.6	71.8	71.3	68.1	55.5	40.6	28.5	48.9
1962	21.3	22.4	33.5	47.5	63.5	67.9	70.5	70.1	60.7	51.4	37.2	23.2	47.4
1963	14.9	15.8	34.7	45.7	53.9	66.6	71.0	66.2	59.1	57.3	42.4	21.2	45.7
1964	27.3	25.6	33.0	45.8	59.1	65.3	71.8	65.5	60.3	47.0	41.3	27.9	47.5
1965	23.0	23.6	27.3	41.6	58.2	63.6	66.6	66.7	62.7	47.9	39.8	33.7	46.2
1956	18.8	24.9	35.4	43.0	50.0	67.7	72.5	67.5	60.7	50.8	40.3	28.3	46.7
1967	28.6	21.9	33.1	47.1	51.4	70.2	68.3	66.0	59.3	49.6	35.6	31.7	46.9
1968	22.3	22.5	35.9	48.8	52.6	65.0	69.8	71.2	66.3	54.2	41.4	28.3	48.2
1969	23.9	28.5	34.2	47.9	56.0	63.9	73.7	72.6	64.5	51.0	39.9	27.5	48.6

Total Precipitation (Inches)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ann'l
1940	.82	1.95	2.21	1.97	3.11	8.15	2.94	6.78	1.63	2.56	3.01	2.32	37.46
1941	1.02	.36	1.12	1.67	2.10	2.62	2.67	2.38	1.14	2.21	2.54	1.97	21.80
1942	1.40	2.58	3.79	1.95	4.02	.93	3.30	4.27	3.30	3.23	2.45	2.36	33.58
1943	1.75	2.14	2.43	2.99	7.67	1.85	4.86	1.32	2.08	1.26	1.67	.20	30.22
1944	1.06	1.23	2.29	2.76	3.82	3.47	1.34	3.08	1.14	1.15	1.56	1.23	24.13
1945	.19	1.28	3.19	3.03	7.39	3.58	2.88	2.44	4.71	2.85	1.21	1.44	34.19
1946	1.27	2.46	2.70	.40	4.19	5.30	.50	3.60	1.24	2.93	1.61	3.78	29.98
1947	3.75	.28	2.43	5.23	5.54	2.57	4.74	6.03	4.39	.58	1.21	1.42	38.17
1948	1.00	4.53	1.83	1.28	5.69	2.56	1.41	1.08	.83	1.12	2.52	1.32	25.17
1949	2.14	2.09	1.97	1.88	2.58	2.46	3.25	2.54	2.49	4.35	1.00	3.44	30.21
1950	3.19	3.33	1.84	3.88	2.74	1.98	2.48	2.77	3.97	3.13	3.98	2.40	35.69
1951	2.47	2.09	2.60	2.32	2.93	2.75	1.91	1.89	2.14	4.46	2.77	5.32	33.65
1952	2.39	1.21	2.80	2.43	1.98	.85	1.96	1.33	1.50	1.21	2.44	1.62	21.72
1953	1.72	.59	2.69	3.15	1.59	2.53	1.43	1.61	1.56	.83	1.06	1.69	20.45
1954	1.91	3.11	4.11	3.04	.96	2.99	1.06	.37	1.62	4.29	1.05	1.91	26.42
1955	1.33	2.00	1.97	1.94	1.59	2.33	2.29	3.64	1.62	2.99	3.80	1.09	26.55
1956	1.36	2.25	2.90	4.14	4.83	2.03	1.38	4.00	.54	.45	2.11	1.99	28.78
1957	1.29	1.54	1.54	4.76	2.69	4.24	3.95	1.34	5.00	2.77	2.30	3.79	35.21
1958	.62	.68	.53	1.12	.91	1.47	2.83	1.95	2.32	1.34	1.95	.14	15.86
1959	2.56	1.80	1.52	3.16	2.66	.22	.79	4.18	2.93	3.68	2.99	3.69	30.18
1960	2.43	1.94	1.32	3.02	1.95	5.14	1.21	1.25	.37	1.62	.74	.55	21.54
1961	.42	2.08	2.73	4.30	2.27	2.78	2.59	4.39	3.25	1.20	2.00	1.24	29.25
1962	1.95	2.02	.98	1.33	1.05	4.26	1.63	2.97	2.27	1.80	1.74	1.46	23.46
1963	.88	.74	2.64	2.91	2.20	1.52	1.43	1.95	1.02	.30	1.04	1.05	17.68
1964	1.46	.78	1.09	3.98	2.12	2.08	1.44	2.87	1.68	.42	.70	1.58	21.00
1965	2.53	2.49	2.94	2.39	1.28	1.90	2.16	2.52	2.82	2.55	1.19	3.10	27.87
1966	.81	1.08	2.36	3.30	1.63	2.48	2.47	3.34	1.26	1.35	3.33	3.87	27.28
1967	1.20	1.19	.70	2.88	1.29	7.58	2.38	3.85	2.15	3.72	2.24	4.60	33.78
1968	2.19	1.71	1.84	1.73	4.22	7.32	3.28	3.33	2.33	1.23	2.33	2.84	34.35
1969	2.57	.09	1.36	3.84	4.05	3.47	4.12	.83	.40	2.31	2.14	.87	26.05

PROBABILITIES FOR SELECTED TEMPERATURES*

Temp (°F)	Spring 90%	Spring 50%	Spring 10%	Fall 10%	Fall 50%	Fall 90%
	Percent Probability of Indicated Temperature, or Lower, Occurring On or After Date in SPRING			Percent Probability of Indicated Temperature, or Lower, Occurring On or Before Date in FALL		
32	Apr 16	May 1	May 16	Sep 28	Oct 14	Oct 30
28	Apr 2	Apr 17	May 2	Oct 15	Oct 31	Nov 16
24	Mar 19	Apr 3	Apr 18	Oct 29	Nov 14	Nov 30
20	Mar 10	Mar 25	Apr 9	Nov 7	Nov 23	Dec 9
16	Mar 2	Mar 17	Apr 1	Nov 16	Dec 2	Dec 18

*"Michigan Freeze Bulletin", Research Report #26, Michigan State University, May 1965.

STATION HISTORY

Weather records in Mount Clemens began on August 1, 1896. The station was located in a small park beside the railroad station house with agents making the observations. On November 21, 1905, the station was moved to the City Waterworks. On December 1, 1925, the station was moved to the top of the Administration Building, Selfridge Field, 4.6 miles east of Mount Clemens Post Office

Precipitation, Evaporation and Infiltration

The average annual precipitation at the base for the period 1940 through 1969 was 28.07 inches as is shown in Table 1.1. Precipitation is well distributed throughout the year with summer precipitation in the form of afternoon showers and thundershowers spawned by migratory frontal activity: 15.62 inches, or 56% of the total, falls during the May - October season. Typically, June is the wettest month and January the driest.

The average annual snowfall for the same time period was 30.0 inches, ranging from an 11.2 inch minimum to a 54.9 inch maximum. The average date of the first one-inch snowfall is December 2.

Data from a class "A" evaporation pan at Dearborn, Michigan indicate that evaporation potential during the growing season (35.1 inches) is more than twice the average annual precipitation. The pan factor at the base should be relatively high due to the large percentage of paved and roofed areas. On an annual basis, however, evaporation is approximately equal to precipitation.

With summer evaporation exceeding precipitation and frozen winter ground precluding infiltration, spring and fall remain as the main periods of infiltration and ground water recharge. A figure of 95,000 gallons per day per square mile (gpd/mi^2) is often used for recharge to clay and till glacial drift in Michigan (Vanlier, et al., 1973). This value equals 2.0 inches of precipitation, or 7.1% of the average total.

Temperature

The same 1940-1969 period of record yields a mean temperature of 48.3° F with maximum and minimum temperatures of 100° and -13° F, respectively. Maximum and minimum temperatures are moderated somewhat by the presence of Lake St. Clair. See Table 1.1.

The average date of the first freezing temperatures is October 14 and of the last, May 1. July is the warmest month with a 72.0° F mean temperature. The lowest monthly mean is 24.1° F in January.

1.5.2 BIOTA

Selfridge Air National Guard Base has a limited natural wildlife habitat. The majority of the base area is dedicated to aircraft flight activities (runways, aprons, hangers, etc.) along with necessary roadways, parking areas, and operational and residential buildings. There is also a considerable area in the southeast portion of the base dedicated as a golf course. There are no significant surface water resources on the base itself.

No data base was available with respect to the fauna to be found on the base property specifically. It can be asssumed, however, that bird and wildlife generally associated with this region could be found on site. These would include:

Birds:	American Robin
	Common Grackle
	Starling
	House Sparrow
	Brown Cowbird
	Red Wing Blackbird
	Bluejay
	Song Sparrow
	Kildeer
	Common Flicker
	Barn Swallow
	Common Crow
	Cardinal
Mammals:	Opossum
	Shorttail Shrew
	Pygmy Shrew
	Eastern Mole
	Raccoon
	Spotted Skunk
	Striped Skunk
	Red Fox

Woodchuck
Thirteen-Lined Squirrel
Eastern Chipmunk
Eastern Gray Squirrel
Eastern Fox Squirrel
White-Footed Mouse
Deer Mouse
Meadow Vole
Pine Vole
Eastern Cottontail
White-tail Jackrabbit
White-tail Deer

The relatively high activity level on the base precludes its being a permanent habitat for the larger mammal species, although all are known to occur on a transient basis around the base periphery.

Given the lack of terrestrial and aquatic habitats on site and the highly developed areas adjacent to the site, no protected species are likely to occur on or near the site.

1.5.3 Geology, Physiography, Topography and Drainage

Regional - Selfridge Air National Guard Base is located on the west shore of Lake St. Clair. This position has been the primary influence on the existing physiography, topography and drainage at and near the site.

The base is located in an area mapped as a glacial lake bed which was deposited in the ancestral Lake St. Clair when it stood at a higher stage as the last of the Pleistocene glaciers melted. This depositional setting has resulted in a surface of little relief sloping gently toward the lake. The lake bed deposits are bordered on the west by a waterlaid moraine which lies on the west side of the City of Mount Clemens and roughly parallels the present shoreline.

Relief on the lake bed deposits results from natural and manmade surface drainage and the presence of glacial lake shorelines representing earlier, higher lake levels. These latter features are still reflected in the

topography as subdued ridges. Two such ridges appear to be generally defined by the routes of Sugar Bush Road, which presently ends at the north edge of the base, and Gratiot Avenue located west of the base. An earlier (1952) topographic map reveals that both the ridge and Sugar Bush Road traversed the northwest corner of the base at that time. Drainage from the area is to Lake St. Clair via the Clinton River which discharges to the lake immediately south of the base and numerous other smaller rivers, streams and drains which also flow directly to the lake. Drainage density is fairly high, reflecting the generally low permeability of the surficial soils.

Base - Present base topography results from the combination of the location on the lake bed plain and cutting and filling operations conducted over the years. With the exception of a few small embankments associated with construction, maximum present relief on the base appears to be approximately ten feet between the elevations of 585 feet msl at the extreme northwest corner of the base to the present shoreline defined by the 575-foot mean lake elevation. Most of the base, however, lies at or below 581 feet msl.

Although the base is very close to the Clinton River, North River Road, which runs along the south edge of the base, has been identified as a drainage divide, excluding the base from the Clinton River drainage basin. All drainage from the base is apparently directly to Lake St. Clair via an unnamed drain near the southeast corner and Tucker Jones Drain which discharges to the lake near the northeast corner of the base. The latter also accepts drainage from off-base areas to the north and northwest of the base. Surface drainage from the interior of the base is to these two main drains via several perimeter drains and interior drains in the northeast and western areas of the base. There is a small area on the southwest corner of the base which receives drainage from off-base, which then discharges to the perimeter drain. Present drainage patterns as indicated by the USGS topographic map are shown on Plate I. Inspection of the older topographic map and air

photos indicates that these drainage patterns have been altered through time to acccomodate operations as the base has grown to its present configuration. For example, an improved drainage ditch crossed the center of the base until some time between 1940 and 1951, when it was filled in to allow construction of a new runway complex.

The base is protected from flooding by a system of dikes and drainage ditches. It has therefore been excluded from the 100-year flood plain as defined in the 1980 Flood Insurance Study of Harrison Township conducted for the Federal Emergency Management Agency.

Glacial Drift Geology

Area - The near-surface geology at the base is the result of Pleistocene glaciation, since modified by post-glacial fluvial and lacustrine processes and the activities of man.

The base is located in an area mapped as clay lake beds. These sediments, in turn, are overlain by two glacial lake shorelines before the lake bed grades into ground moraine deposits approximately one and one-half miles west of the base. The locations of these features are discussed in greater detail in the section on Physiography.

Base - This depositional setting has resulted in primarily clayey glacial drift beneath the base. As revealed by the logs of numerous soil borings installed at the base, these clays contain variable but generally minor amounts of silt, sand and gravel with occasional lenses of silty and sandy sediments. The presence of these coarser fractions suggests that the clays are not entirely lacustrine in origin but probably also represent till deposits associated with the ground moraine to the west. The locations of soil borings used in this analysis are shown on Plate II; also shown on this plate are the locations of two Generalized Geologic Cross Sections constructed from selected borings to show overall surface and subsurface relationships. Sand and/or fill material is found at or near the surface in some

areas, mostly on the west side of the base, as indicated by the Isopach Map of Sand Within 10 Feet of Surface (Plate III). The greatest thickness of surficial sand exists at the extreme southwest corner of the base where sand was logged from the surface to 24 feet bgl in two borings. These surficial sands are probably from three sources. The first is the aforementioned glacial lake shoreline on which Sugar Bush Road presently stands. The second is alluvial deposits from the Clinton River. A final source is fill material placed to raise much of the base to its present level.

Most of the soil borings were for runway and other construction and, consequently, were not very deep. Some of the deeper borings, however, reveal sandy intervals at varying depths. The locations of these deeper borings and the intervals of deeper sand are shown on Plate IV. The variability in reported depths and thicknesses of these intervals, as well as their absence in other deep borings, suggest that they occur as lenses of limited extent rather than a continuous stratum.

The Generalized Geologic Sections shown on Plates VI and VII have been constructed from selected boring logs as shown on Plate II. These cross sections are presented as an overall picture of the subsurface relationships present but cannot be regarded as definitive due to the variable nature of these relationships.

Bedrock

The base and surrounding area are underlain by the Antrim Shale which subcrops the glacial drift at depths of from less than 100 to approximately 150 feet. Two of the available logs from the base have reported rock at approximate depths of 70 and 95 feet. Given the minimal relief at the base, this difference must be attributed to bedrock topography. The log from domestic well No. 4 reports black slate at 92 feet bgl. Locations are shown on Plate I.

The Antrim Shale is a cinnamon brown to black and dark gray bituminous shale which is

thin bedded to fissile and fossiliferous. The base is located on the southeast rim of the Michigan Basin which resulted in a gentle dip to the northwest in the bedrock.

Soils

The USDA soils maps for the area of the base have been combined and are presented in Plate V. Inspection of this map reveals that the dominant soil type is "made land", i.e. fill material. Virtually all of the runway and aircraft handling areas have apparently been filled.

Most of the rest of the base is covered by clay soils of the Toledo or Paulding series, reflecting the old lake bed. Exceptions to this are areas of sandy soils at the north edge and southwest corner of the base. These areas appear to be remnants of the glacial lake shoreline which once traversed the base. Some of the sand at the southwest corner may be the result of alluvial processes associated with the Clinton River which apparently are also responsible for the sandy loams at the southeast corner of the base and along the south edge.

Ground Water

Occurrence and Availability in Area - The study area and immediately surrounding area are known as marginal sources of significant ground water supplies. Typical yields from wells in both the glacial drift and the bedrock are reported to be less than 10 gallons per minute (gpm) (Nowlin, 1973 and Twenter, et al., 1975). In both cases, this is due to the absence of a sufficient volume of sediments with effective porosities and permeabilities (hydraulic conductivities) high enough to store and transmit much water.

The sand and gravel lenses found at depth in the drift at some locations appear to yield adequate supplies for domestic purposes. A request to the Michigan Department of Natural Resources for all wells of record in Harrison

Township and those in Chesterfield Township within one mile to the north and west of the Base produced only the eleven logs summarized in Table 1.2; graphic representations of three typical logs are presented on Plate VIII. All of the wells are completed in the glacial drift. This is the general rule in this area as the water in the bedrock is known to be highly mineralized and unsuitable for most purposes.

Comparison of completion depths in these wells with reported water levels indicates that these lenses of sand and gravel occur under confined conditions. The same data suggest that some of these bodies may have been deposited contemporaneously and under similar conditions. These strata apparently are not present everywhere as they were not reported in wells 4 and 8.

Water Quality - As mentioned, ground water from the bedrock in the area is reported to be highly mineralized. Specifically, water from the Antrim Shale and the underlying Traverse Formation contains chlorides in excess of recommended limits. This mineralization also apparently impacts the overlying glacial drift. As reported in the USGS Hydrographic Atlas-469, some of the wells completed in the drift produce water with elevated levels of chloride, magnesium, sodium and potassium. Some ground-water movement into the drift from the bedrock is suggested by this fact.

Base Hydrology - The base's location in an area of clayey lacustrine and till deposits makes the presence of extensive shallow aquifer material unlikely. This conclusion is corroborated by analysis of the boring logs from the base. At the same time, most of the glacial drift beneath the base appears to be saturated due to its proximity to Lake St. Clair. Water level data from several borings indicate that saturation extends to at or near ground level.

These shallow water levels are influenced by the type of material at a given location and the presence or absence of surface and subsurface drains. Such drains will lower water levels over a larger area in the more permeable

Table 1.2

Summary of Domestic Water Wells

Well No.	Total Depth	Screened Interval	Formation	Static Water Level feet bgl
1	67	63 - 67	med.-coarse sand	20
2	75	72 - 75	coarse sand	21
3	77	74 - 77	coarse gray sand	12
4	129	dry hole		NA
5	60	58 - 60	coarse gray sand	10
6	57	54 - 57	med. gray sand	6
7	75	72 - 75	med. gray sand	20
8	102	100 - 102	coarse gray sand	20
9	50	46 - 50	sand & gravel	6
10	28	25 - 28	med. gray sand	3
11	28	25 - 28	mixed gravel	5

sandy soils than in clays. These drains will also control the directions of shallow ground water flow at the base, i.e. flow from any given point should be toward the nearest surface or subsurface drain.

A number of borings at the base drilled to depths of 30 ft. or more have penetrated apparent lenses of sand and/or gravel which could prove adequate to be aquifers capable of yielding quantities of ground water for domestic supplies. As mentioned, these strata appear to be generally limited in areal and vertical extent as evidenced by the discrepancies between closely spaced borings. Some of the logs from the northwest corner of the base, near the West Ramp seem to indicate a fairly persistent sand horizon up to 7.5 feet thick at depths of from 22.5 to 35.5 feet. The same pattern, however, is not reflected in other borings in the immediate area. The two domestic wells immediately northwest of the Base (#10 and #11) also report sandy intervals in this depth range.

The only well reportedly still in service at the base is located on the extreme south edge near Building 1695. It is reported to be completed at a depth of 52 feet. A log of the well was not available so it is uncertain whether the aquifer in which it is completed is one of the deeper sand lenses or an unprotected, water table aquifer of presumably alluvial sands which extend to the surface. This well is currently capped and protected by a small shed.

A second well - behind Building 1537 in the southwest corner of the base - is no longer in service. The log from this well indicates that it is completed in the interval 53-59 ft. bgl, in a gravel which is overlain by over 40 feet of apparent clayey material. This would suggest that the well still in service is also completed in an aquifer protected to some degree by overlying clays. This well is also capped.

Geologic Aspects of Potential Migration

Aquifer Protection - The shallowest usable aquifer(s) beneath the base appears to be the lenses of sand and gravel which occur between 20 and 65 ft. bgl. at varying depths. Most of these do not appear to be of significant areal or vertical extent but could possibly yield enough water for a domestic supply. The greatest concentration and extent of these lenses occurs at the northwest corner of the base where several of the borings reported sandy intervals at depths ranging from 22.5 to 33.5 ft. bgl. The fact that these sands were absent in other borings suggests that they do not represent a continuous stratum.

A second possible shallow aquifer is indicated by the borings at the extreme southwest corner of the base which apparently penetrated alluvial sands. These sands may persist for some distance along the river channel and could constitute a usable aquifer. Some of the domestic water well logs from the area south of the base record this shallow sand body, indicating that it may persist off base.

With the exception of these alluvial sands which reach the surface, all of the other potential aquifers beneath the base are apparently protected to varying degrees by the glacial clays above them. The degree of protection afforded by these clays varies with their thickness. It is possible that these clays are not as thick or are entirely absent in areas off the base or on the base where soil boring data are sparse. This is particularly true along the Clinton River where erosion of glacial drift and deposition of alluvial materials have been active. If such a "window" in these protective clays is present and increases the hydraulic communication between shallow and deeper permeable materials, the potential for impact on any deeper aquifers would increase substantially. Existing data are insufficient to determine the presence or absence of such a window.

Additional protection should also arise from the confined, or artesian, conditions,

which, based on the domestic well log data, appear to exist in the deeper sands overlain by clay. Confined conditions require the presence of an overlying low-permeability horizon and result from a potentiometric surface in permeable materials which is higher than the upper limit of the permeable zone. By definition, the hydraulic potential in and consequent flow from these strata appear to be upward, decreasing the potential for impact from the surface.

Migration to Aquifers - The only potential usable aquifer subject to direct impact from surface activities appears to be the alluvial sands at the southwest corner of the base. These sands appear to be unprotected. Migration through these sands should be for short distances, however, as they presumably discharge directly to the Clinton River during most of the year.

In order to reach the deeper, protected sands at other locations on the base, potential contaminants would have to travel through the overlying glacial clays. Such clays typically exhibit low permeabilities and should greatly retard fluid movement. They should also tend to attentuate the deleterious properties of any ground water moving through them by cation exchange, sorption and other physiochemical processes. Additionally, the data indicate that hydraulic potentials in at least the deeper sand lenses may be upward, further reducing the possibility of impact. Given their shallower depths, it is uncertain whether this relationship also applies to the sand intervals identified near the northwest corner of the base.

One possible migration route through these clays arises from the numerous boring which have been installed about the base. Improper grouting of these holes, particularly those which breached the clay, could result in a significantly reduced degree of protection. Again, the inferred confined nature of these potential aquifers would be a factor in determining the effects of improperly plugged holes. available data do not indicte the

grouting methods employed in these borings, if any. Grouting of these borings at this time probably is not a feasible approach as it would require precise reloction and redrilling of borings which are, in some cases, decades old.

Migration to Surface Water - Given the low permeabilities and apparently continuous nature of the glacial clays underlying the base, the main escape route for fluids placed on or in the ground or those leached from solid materials is to surface water bodies. As discussed, surface water and near-surface ground water does flow to the drains or field tiles present at the base.

Fluids flow to lower potentials in the direction(s) of least resistance, i.e. highest permeabilities. Since vertical permeability through the clays is presumably quite low, fluids must flow laterally through the surficial sands to points of lower hydraulic potentials. This analysis should also apply to lesser extent to predominantly clay soils as their horizontal permeability is typically higher than vertical permeability.

In all of the soils and particularly in the clay soils, the potential for lateral migration is increased by the presence of underground utilities such as waterlines, sewers, electric and telephone conduits. Trenches cut for these structures are usually backfilled with sand to facilitate drainage. Although not quite as efficient, such sand-backfilled trenches are analogous to drain tiles, collecting ground water and transmitting it if an outlet exists. Engineering drawings indicate that extensive areas of the base are underlain by drain tiles. Also, the sanitary sewer system at the base is known to collect significant infiltration of shallow ground water. Both storm water and sanitary systems are therefore subject to impact from any contamination present in the shallow ground water.

The ultimate discharge for such laterally migrating ground water must be to surface water bodies in and around the base, whether they are man-made drains, the Clinton River, or Lake St.

Clair. The storm water drainage collected at the base flows to a number of lift stations which discharge directly to Lake St. Clair or to the Clinton River.

1.5.4 LICENSES AND PERMITS

An unique feature of Selfridge ANG Base is the number of uniformed services represented on base. In addition to the three units of the Air National Guard (ANG) located on base, the following services are all represented.

U.S. Air Force (USAF) - three units
U.S. Air Force Reserve (USAFR) - three units
U.S. Army (USA) - three units
U.S. Navy (USN) - one unit
U.S. Marine Corps (UMSC) - one unit
U.S. Coast Guard (USCG) - one unit

All of these services operate under permit to Michigan ANG, which maintains administrative control over the entire facility.

1.5.5 LEGAL ACTIONS

No present or past legal problems with respect to hazardous waste contamination at Selfridge ANG Base were discovered during the course of this investigation.

2.0 FINDINGS

2.1 INTRODUCTION

Activities that generate hazardous wastes and methods historically used to dispose of these wastes were investigated by means of a records search and interviews with base military personnel, civilian employees, and retired personnel. Potential disposal sites and approximate dates of operation were determined by analysis of aerial photographs taken during the years of base operation. The information gained through the records search and interview phase was used to assess the potential for ground water contamination and migration of contaminants beyond base boundaries. Figure 2.1 presents the decision tree methodology used in the assessment of waste disposal practices.

2.2 PAST ACTIVITIES REVIEW

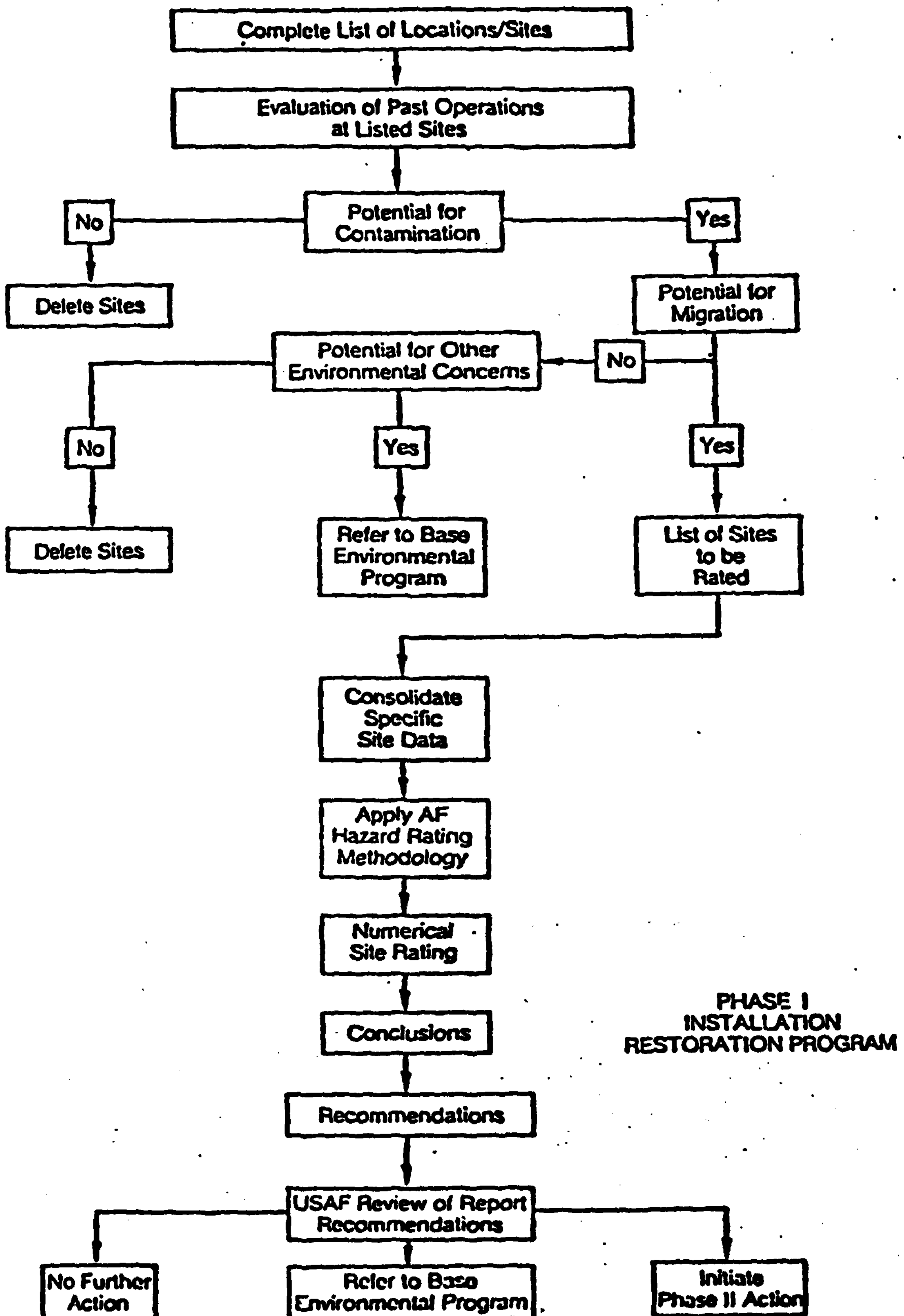
Determination of past activities and disposal practices was based primarily on the interview phase of the project. Written records are not maintained by the Armed Services for more than two to three years. Unfortunately, the information obtained during the interview phase was often contradictory or not sufficiently detailed to be of much use. In addition, there was noticed occassional reluctance among some interviewees in discussing disposal practices. The reason for this is unknown. There also exists some uncertainty as to the identification of specific materials in use on base and the time periods of use. Very often shop personnel were unaware of the name of the materials they were using during day-to-day activities. Degreasers and solvents were simply "engine wash" or "solvent" and records do not exist that allow the investigative team to identify or quantify the types of materials used. It is known, for instance, that the military used carbon tetrachloride at one time as a solvent and degreaser. It is impossible, however, to determine the time period of use or the quantities used.

2.3 WASTES GENERATED BY ACTIVITY

Hazardous wastes are, and have been, generated via a wide variety of activities at Selfridge ANGB. In

FIGURE 2.1

DECISION TREE



general it can be stated that the greatest amount of hazardous waste is generated by maintenance of aircraft and ground vehicles, with lesser amounts generated by the various grounds maintenance activities (entomology, electrical, boilers, housing, etc.), and fuels. A complete list of shops can be found in Appendix D.

The following sections will discuss those activities that are known to have generated hazardous wastes.

2.3.1 Aircraft Maintenance

Aircraft maintenance operations generate hazardous wastes in the form of contaminated fuels, hydraulic fluids, solvents, degreasers (PD680-1 and -2), and waste crankcase oil in the case of piston driven engines. Solvents which have been used at Selfridge ANGB include carbon tetrachloride, trichloroethylene, methyl ethyl ketone, acetone and possibly other halogenated and non-halogenated organic compounds. Many of these materials are listed as hazardous by RCRA (e.g. halogenated organic solvents) and are thus covered by Federal law. Others are not RCRA listed (e.g. certain degreasers and waste crankcase oil), but because of their characteristics require careful handling and disposal. There are, and have been, several paint shops on base which have used a variety of organic and inorganic paint removers. The paint shops have produced wastes containing varnishes, lacquers and lead based paints.

Disposal of wastes generated from maintenance activities was carried out in several different manners. Waste oils were spread on dirt roads for dust control and/or taken off base by private contract. Flammable liquids including oils, solvents, contaminated fuels, and paints, were burned by the fire department during training exercises. Solids such as contaminated rags and empty containers were sent to the landfills. Many types of solvents and degreasing compounds were disposed of by pouring down the drain (ultimately to the storm or sanitary sewer or septic tank), landfilling, or were consumed during use.

2.3.2 Ground Vehicle Maintenance

Vehicle maintenance produces the same basic types of hazardous wastes as aircraft maintenance. Wastes produced include RCRA listed materials such as chlorinated solvents and battery acid, as well as less hazardous materials such as ethylene glycol and crankcase oils. Waste materials were handled in the same general manner as aircraft maintenance wastes.

2.3.3 Grounds Maintenance

The grounds maintenance shops generated a number of different waste compounds; among them being RCRA listed materials such as chlorinated solvents, out-dated pesticides, and empty pesticide containers. Paint stripping sludges, small amounts of oils, and anti-scale compounds from boilers were also generated. Wastes were handled in the same manner as aircraft maintenance wastes.

Electrical Services include a number of transformers containing PCB contaminated oil. None of the interviewees expressed any knowledge of spills or leaks of PCB contaminated oils from transformers.

In August, 1979 high concentrations of DDT and chlordane were noted in stormwater drainage from the area south of the E-W Runway. This area had been used for land application of sludge contaminated with five gallons of DDT and thirty five gallons of chlordane. The pesticides were deposited in the sludge digester at the base WWTP by entomology shop personnel after being ordered to dispose of residual stocks of these materials. Disposal of outdated or unused pesticides into the sludge digestor was a common practice.

The base and the Michigan DNR conducted laboratory analyses on soil, water, and sediment samples from pump station 507, 508 and 340. The analytical results are presented in Appendix H.

Based on these results, Michigan DNR determined that no environmental problem existed and consequently no further action was required.

2.4 *DESCRIPTION OF DISPOSAL METHODS*

Disposal of hazardous materials was handled in a number of different manners at Selfridge ANGB. Flammable wastes were often burned in the Fire Training Area during training exercises. Waste oils were sprayed on dirt roads for dust control. Some waste petroleum products were taken by private contractor for recycle/reuse. Liquid wastes were often poured down the drain. Empty containers, rags, waste liquids, and sludges were sent to the landfills. The various methods of waste disposal are discussed individually in the following sections.

2.4.1 Fire Training Activities

The Fire Department used flammable waste materials to practice fire fighting techniques. Flammable wastes were put into drums and bowsers by shop personnel. These containers were then taken to the Fire Training Area (FTA) and used during training exercises. The general procedure was to flood the area with water to retard infiltration. Then waste materials were added and the fire ignited. A thirty to sixty second free burn ensued with the fire department then extinguishing the fire.

It is estimated that each burn started with 350-500 gallons of waste materials. Fire department personnel have estimated that approximately 75% of the starting material is consumed in the fire. The Fire Department trained between 8 and 12 times per year. Fire training activities began in 1952.

From 1968 until the present the fire department used JP-4 or Avgas containing less than 10% contaminants. Prior to 1968, training exercises used flammable waste products exclusively.

2.4.2 Disposal on Roadways

Until 1979 waste oils were spread on dirt roads for dust control, particularly West Perimeter Road in recent times. It can be assumed that the oils contained solvents and paint thinners because the practice of segregating wastes was not well established. The investigative team was unable to determine the frequency of oiling or the quantity of material used in this manner, however, the consensus of the interviews was that only minimal applications occurred.

2.4.3 Disposal by private contract

Waste petroleum products have been disposed of by private contract at Selfridge ANGB since at least the early 1950's. Unfortunately there is conflicting information about the amounts of liquid wastes removed from the base by private contract. One interviewee indicated that all liquid wastes were taken off-base, while others indicated that only recoverable petroleum products were disposed of through private contract.

2.4.4 Disposal to the Sewer System

A fairly common method of liquid waste disposal was to pour wastes down the drain. Both storm drains and the sanitary system were utilized in this manner. The investigative team was unable to determine the extent of this practice.

2.4.5 Landfills

All solid materials generated on base were disposed of in the base landfills. Rags, empty pesticide containers, and fuel tank bottoms sludges were put into dumpsters which were then taken to the current landfill. Small amounts of liquid waste, 5 gallons or less, were frequently put in cans and thrown into the dumpsters as well. Several interviewees stated that drums of waste paints and solvents were frequently thrown

in the landfills also. Disposal of drummed liquid wastes to the landfill was confirmed by interviewees that worked in the areas.

2.4.6 Ordinance Disposal

The Explosives Ordinance Disposal unit of the 191st CAM Squadron has disposed of all spent propellant cartridges (e.g. seat ejectors) outdated munitions, firecrackers confiscated by law enforcement agencies, and any other items with an explosive charge by incineration in an oil fired furnace. The remaining ash and metal casings are buried in a pit near Building 883.

2.4.7 Wastewater treatment

During initial development and construction of Selfridge ANGB, sanitary sewage treatment consisted of septic tanks with subsurface seepage fields. An Imhoff tank and drain field was constructed in the 1930's where the dental clinic is presently located. In 1941 the present activated sludge plant was completed. Plant effluent was discharged to the Clinton River. Sludge was anaerobically digested followed by land application on various locations on base (Figure 2.2). The base discontinued use of the treatment plant in 1977 and now discharges to the Detroit Metropolitan Sewerage System. There are, however, several buildings on base that still utilize septic tanks and drain fields.

As noted previously, a common disposal practice consisted of pouring waste liquids down the drain. It is possible that a portion of the materials so disposed of would be adsorbed onto sludge particles and be deposited onto the soil during land application of digested sludge.

2.5 DISPOSAL SITE IDENTIFICATION AND EVALUATION

The on-site facilities used for management and disposal of hazardous waste are summarized below:

--Landfills (3)
--Sanitary Wastewater Treatment Facilities

--Storm Sewer System
--Fuel Spills Sites (2)
--Fire Training Areas (2)
--West Perimeter Road
--Ordnance Disposal Site

These sites are evaluated in detail in the following section and can be located on Figure 2.2.

2.5.1 Landfills

Three areas were used in the past for landfilling of residential and industrial waste. From 1930 to 1955, a natural depression on the east side of the base, commonly called Tucker Creek, located south of the present 900 housing complex and north of building 970, was used for disposal of waste materials. The refuse was brought to the Tucker Creek Dump, burned and then buried in the depression. Demolition materials, residential refuse, and industrial waste materials typical of those found on a military base at this time, such as carbon tetrachloride and trichloroethylene were disposed in this area.

From 1955 to 1975, the Northwest Landfill, located in the northwest corner of the base, was used for landfilling of waste products. At one time, this site was a natural sand pit from which the sand was excavated completely, down to blue clay, for construction of the runways. Demolition materials were placed on the bottom of the pit followed by landfilling of residential and industrial waste. Clay and clayey sands were used for daily cover. This site contains industrial waste products such as solvents, paint thinners, paint strippers, waste oils and fuels. Fuel Management reports disposing of 50 to 150 gallons of tetraethyl lead at this site during its operation.

The final known landfill site, the Southwest Landfill, is located in the southwest corner of the base. The 40-acre site operated from 1970 to 1978 under Michigan Public Act 87, as amended, for the disposal of approximately 5,900 tons per year of residential and

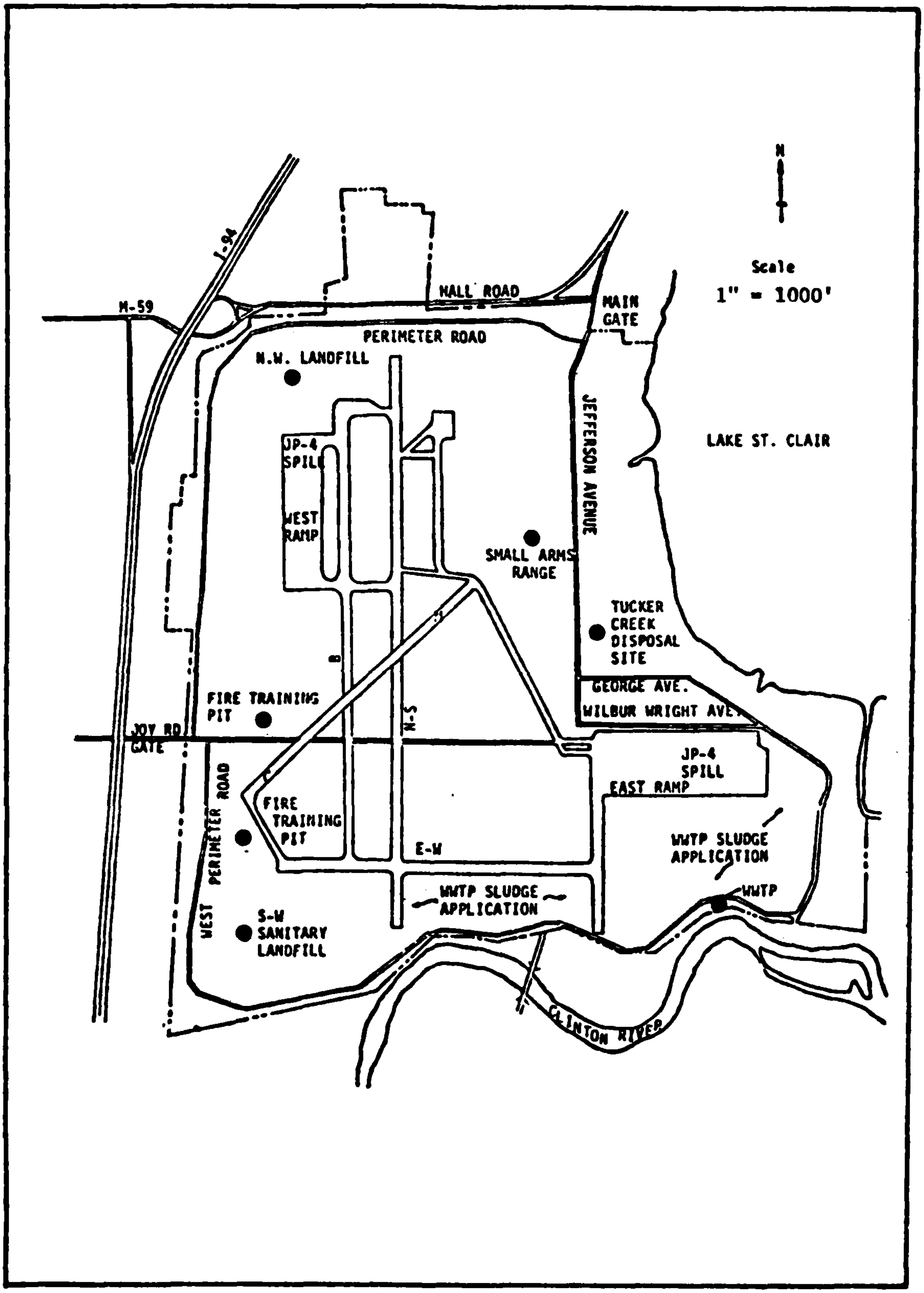


FIGURE 2.2 Disposal Site Locations

industrial waste. Clayey sand was used for daily cover.Typical wastes brought to the site by base tenants and disposed of in this site were demolition materials, residential waste, solvents such as trichloroethylene, carbon tetrachloride, and methyl ethyl ketone, paint strippers and thinners, and waste oils.

During a site inspection in August 1982, the final cover did not appear adequate as evidenced by protruding pieces of scrap metal and the open dumping of garbage bags, empty lubricating oil drums, and demolition materials. Placement of additional cover over the site was observed during a helicopter overflight later in the month.

2.5.2 Sanitary Wastewater Treatment Facilities

In the 1930's, the base constructed a wastewater treatment plant consisting of an Imhoff tank and a subsurface seepage field located at the present dental clinic. In 1941, this was replaced by an activated sludge sewage treatment plant, constructed in the southeast corner of the base. The plant was later expanded to handle 880,000 gallons of sewage per day. The activated sludge treatment process consisted of primary settling followed by aeration, final clarification, chlorination and effluent discharge to the Clinton River. Sludge and settled solids were anaerobically digested and then spread on sludge drying beds. The sludge was ultimately disposed by land application on the present golf course site, behind the 1500 area, and over the area south of the North-South Instrument Runway (Figure 2.2).

Base shops used the floor drains, most connected to the sanitary sewer system, as one method of disposing waste liquids. The treatment plant treated, in addition to domestic sewage, an unknown amount of uncontrolled industrial liquid waste containing solvents, waste oils, thinners, strippers, and waste battery acid. Appendix E presents a metals analysis of digested sludge. No other analyses of sludge samples have been performed.

These data do not indicate that the sludge is hazardous. It must be recognized that the analyses were performed on recently generated sludges, and do not necessarily represent those sludges generated in the past and disposed of on the golf course.

The treatment plant was phased out of operation in 1977 and the Base now uses the Harrison interceptor of the Detroit Sewer System for transporting its sewage to the Detroit Metropolitan Sewage Treatment Plant.

2.5.3 Stormwater Drainage

Stormwater drainage on the Base is handled by a system of ditches, underground drain fields, catch basins, sewers, and seven lift stations for discharge of collected stormwter to the Clinton River and Lake St. Clair. The Base is surrounded by a levee which prevents flooding from the River and Lake.

In the past, aircraft were washed on the East and West Ramps. The wash water drained to the south from the West Ramp and to the east from the East Ramp. The types of hazardous materials washed off the ramps with the wash water include minor amounts of fuels, cleaning compounds, oils and ethylene glycol. The quantity of waste materials disposed in this manner is unknown.

2.5.4 Fuel Spill Areas

Two fuel spills are reported to have have occurred since commencement of Base operations. Approximately 6,000 gallons of JP-4 was spilled on both the East and West Ramps. Remedial cleanup activities were attempted, however, the bulk of the spill drained off the ramps. As reported during interviews with base personnel, a noticeable petroleum spirits aroma appears during extensive wet periods in the vicinity of the spills. The dates of these spills are unknown.

2.5.5 Fire Training Areas

Selfridge ANGB has used two Fire Training Areas (FTA) for training fire department personnel. FTA-1 was used from 1952 until 1967 and was located north of Building 567 (Figure 2.2). This site was an unlined gravel pit. The fire department trained exclusively with flammable waste materials. Waste flammables, (e.g. JP-4, solvents, strippers and thinners) were stored in drums, on site, between fire training exercises. This area has since been turned into a paved parking lot.

Since 1968, the Base has used the Fire Training Area in the southwest quadrant of the base, north of the Southwest landfill site and west of the C Taxiway. The pit was excavated 1 to 1-1/2 feel below ground elevation and filled with broken concrete and demolition materials. A dike surrounds the pit. Stormwater accumulation is drained to the Clinton River through an open ditch.

Historically, an average of 8 to 12 training fires have occurred per year. Each event uses 350 to 500 gallons of JP-4, containing up to a maximum of 10% sediment contaminants. The fuel is fed to the pit via a fuel line connected to a 2,500 glalon storage tank. Fire department personnel estimate approximately 75%of the fuel is consumed per event (25% residue). The fire is extinguished using water and aqueous film forming foam (AFFF).

2.5.6 West Perimeter Road

From the early 1930's to the present, the base tenants have spread waste oils on the dirt section of the West Perimeter Road. Before 1979, the waste oils spread on the road were apt to contain waste solvents and thinners as a base-wide waste separation program was not in practice. The amount of waste applied to the road is not known, but is believed to be minimal.

2.5.7 Ordnance Disposal Site

The Explosives Ordnance Disposal (E.O.D.) section of the 191st CAM Squadron disposes of all spent propellant cartridges (i.e., seat ejectors), old munitions, firecrackers confiscated by local law enforcement agencies, and other items with an explosive charge by burning in an oil-fired incinerator. The remaining ash and metal casing are then buried in a pit near the incinerator on the small arms range near Building 883. The ash and metal casings are not considered a hazardous waste and this site is not considered to be a hazardous materials repository.

3.0 INSTALLATION ASSESSMENT

The salient findings of this investigation are as follows:

1. The study site appears to be underlain by a continuous layer of low-permeability lacustrine clays and clay tills ranging from 34 to over 100 feet in thickness.

2. At some locations, these lacustrine clays are overlain and/or underlain by sandier, more permeable sediments.

3. Some of these more permeable strata may have potential as usable aquifers of limited extent.

4. There is potential for impact on an unprotected possibly usable aquifer in the surficial sands at the south edge of the base. Area domestic well logs indicate that this stratum may extend for several thousand feet beyond base boundries.

5. Due to the attenuating properties and apparent continuity of the glacial clays and the inferred confined conditions existing in the deeper permeable materials, the potential for impact on the deeper strata is minimal.

6. This potential is increased to the extent that the integrity of these protective clays has been compromised, either through natural processes or the activities of man such as excavation or improperly grouted borings and wells.

7. The more permeable surficial materials present - both native and placed by man - could serve to transmit fluids placed on the surface or leached from materials placed on or beneath the ground.

8. Such migration of fluids would be primarily lateral toward surface and subsurface drainage.

9. Dried and liquid wastewater treatment plant sludge was land-applied to the golf course, behind the 1500 building complexes and over the large area south of the East-West Runway by the North-South Runway. In 1979, concentrations of DDT and chlordane were found in soil and surface water

samples from the application site south of the E-W runway, after these pesticides had been disposed of in the sludge digester. Michigan DNR established that the levels observed presented no danger to the environment.

10. In the past, floor drains were used for disposal of industrial wastewaters. Floor drains were connected to oil/water separators prior to discharge to either the storm or sanitary system. Paint thinners and removers and oils were contained in drums and, eventually, either spread on the west perimeter dirt road for dust control, burned in fire training exercises, collected by private oil reclamation firms, or disposed of in landfills.

11. At least three major areas have been used for disposal of solid waste which undoubtedly contained some amount of hazardous materials on the base grounds -- a depression commonly called Tucker Creek between 1930 to 1950, the Northwest Landfill, an excavated sand pit in the northwest corner of the base between 1958 to 1978, and the Southwest Landfill in the southwest corner of the base between the early 1970's to 1980. Both domestic and industrial wastes were disposed of in all three sites. No records were kept stating what materials were disposed of in the dumping sites.

    The Base presently collects all domestic solid waste for disposal off-base.

12. Waste flammables were used for fire-fighting exercises.

13. Two major fuel spills of JP-4 occurred on the West and East Ramps.

4.0 CONCLUSIONS

The information obtained through the interview phase, records search, and hydrogeological investigation was used to assess the potential for ground water contamination and the probability of such contamination migrating beyond base boundries. The following conclusions are based on the above mentioned assessment. Table 4.1 presents a list of the sites and their accompanying HARM scores. Table 4.2 summarizes the various components of the HARM rating for each site.

1. The Southwest Landfill has a relatively high potential for migration of contaminants beyond base boundries. The site contains various industrial solvents, paint wastes, and petroleum products. The Southwest Landfill received a HARM score of 74.7. The quantity of waste was estimated to be moderate based on approximately eight drums of material each year over the ten year life of the operation.

2. Fire Training Area 2 has a moderately high potential for migration of contaminants beyond base boundaries. This site contains petroleum products, estimated to be in large quantities due to the equivalent of six drums per year of materials being deposited and not consumed during the fire training exercises over the fifteen years of its existence. Fire Training Area 2 received a HARM of 71.8.

3. Fire Training Area 1 has a moderately high potential for migration for contaminants beyond base boundaries. This site contains various industrial solvents paint wastes and petroleum products. The quantity of potential residuals at this site was estimated to be large (greater than 85 drums) due to its having been in use for 15 years. Fire Training Area 1 received a HARM score of 70.5.

4. The West Ramp Fuel Spill has a moderately high potential for migration of contaminants beyond base boundries. The site contains an estimated 3000 gallons of JP-4 (a moderate quantity using HARM criteria). This site received a HARM score of 66.4.

5. The Northwest Landfill has a moderate potential for migration of contaminants beyond base boundaries. The site contains various industrial

TABLE 4.1

Priority Ranking of Water Disposal
Sites at Selfridge ANG Base

Rank	Site Name	Date of Operation	Est. Quantity (drums)	Harm Rating
1	Southwest Landfill	~1970-1980	80	74.7
2	Fire Training Area - 2	1967-Present	96	71.8
3	Fire Training Area - 1	1952-1967	90	70.5
4	West Ramp Fuel Spill	Unknown	55	66.4
5	Northwest Landfill	~1956-~1978	88	64.9
6	East Ramp Fuel Spill	Unknown	55	60.7
7	Tucker Creek Landfill	~1930-~1955	88	59.4

Note: The location of these sites can be found in Figure 2.2.

TABLE 4.2

Summary of Site Ratings

Site	Type	Receptor	Waste Characteristic	Pathway	Gross Score	Factor	Score
1	Landfill	63.3	80	80.7	74.1	1.0	74.7
2	FTA	63.3	80	72.2	71.8	1.0	71.8
3	FTA	57.8	100	64.8	74.2	0.95	70.5
4	Fuel Spill	54.4	64	80.7	66.4	1.0	66.4
5	Landfill	61.1	63	80.7	68.3	0.95	64.9
6	Fuel Spill	60	64	66.7	60.7	1.0	60.7
7	Landfill	52.2	63	72.2	62.5	0.95	59.4

solvents, paint wastes, and petroleum products. The assumption of a large waste quantity is based primarily on the extensive period over which this landfill appears to have been operational. Photo interpretation indicated this site may have been in use for a period of approximately 22 years. The disposal of an average of only four drums of waste per year would thus be enough for a large rating. The Northwest Landfill received a HARM score of 64.9.

6. East Ramp Fuel Spill area has a moderately high potential for migration of contaminants beyond base boundaries. This site contains an estimated 3000 gallons of JP-4 (moderate quantity using HARM criteria). The site received a HARM score of 60.7.

7. The Tucker Creek Landfill has a moderate potential for migration of contaminants beyond base boundaries. This site may contain various industrial solvents, paint wastes and petroleum products. As in the case of the Northwest Landfill, the large quantity assumption is based on the longevity of this landfill operation. The approximately 25 years of operation would require only 3 1/2 drums of hazardous materials per year to attain the large quantity rating. Because the operation of this site is based strictly on photo-interpretation, and no knowledge of it was expressed in any of the interviews, the confidence level rating was "suspected". The Tucker Creek Landfill received a HARM score of 59.4.

In addition to the above listed and rated sites, there are two other areas which present a slight potential for residual contamination by hazardous materials. The area of application of sludge from the sewage treatment plant (see Section 2.5.2) could have been contaminated by heavy metals. Incidental contamination of the West Perimeter Road (see Section 2.5.6) by contaminants in the waste oils used as a dust palliative could also have occurred. The broad expanse of area involved in both of these situations, along with the relatively small amounts of material disposed of, resulted in their not being rated.

5.0 RECOMMENDATIONS

Seven sites at Selfridge ANG Base are known to have been repositories for hazardous wastes. As an aid in determining the relative need for follow-up work, the hazardous assessment rating methodology (HARM) was applied to each site. To further assess the potential for contaminant migration beyond base boundaries the following recommendations are made:

1. The Southwest Landfill has a relatively high potential for migration of contaminants beyond base boundaries. Monitoring of this site is recommended. The recommended monitoring includes three test bores, each drilled until ground water is encountered. One test bore should be drilled up gradient of expected ground water flow (west), one within the site, and one down gradient of expected ground water flow (east). Soil samples should be taken at ground level and at two foot intervals until perched water is reached. When ground water is encountered, it too should be sampled. All samples should be analyzed for the parameters listed in Table 5.1 because this site received a wide variety of materials.

2. Fire Training Area 2 has a moderately high potential for migration of contaminants beyond base boundaries. Monitoring of this site is recommended. the recommended monitoring includes three test bores, each drilled until ground water is encountered. One test bore should be drilled up gradient of expected ground water flow (west), one within the site, and one down gradient of expected ground water flow (east). Soil samples should be taken at ground level and at two foot intervals until perched water is encountered and at five foot intervals thereafter. When ground water is encountered, it too should be sampled. Samples should be analyzed for volatile organic compounds, phenol, and total organic carbon. This parameter list is based on the site having been contaminated with solvents, POL, and fuels.

3. Fire Training Area 1 has a moderately high potential for migration of contaminants beyond base boundaries. Monitoring of this site is recom-

mended. The recommended monitoring includes three test bores, each drilled until ground water is encountered. One test bore should be drilled up gradient of expected ground water flow (west), one within the site, and one down gradient of expected ground water flow (east). Soil samples should be taken at ground level and at two foot intervals thereafter. When ground water is encountered, it too should be sampled. All samples should be analyzed for volatile organic compounds, phenol, and total organic carbon.

4. The West Ramp Fuel Spill has a moderately high potential for migration of contaminants beyond base boundaries. Monitoring of this site is recommended. The recommended monitoring includes three test bores, each drilled until ground water is encountered. One test bore should be drilled up gradient of expected ground water flow (west), one within the site to verify the continued presence of the material, and one down gradient of expected ground water flow(east). Soil samples should be taken at ground level and at two foot intervals until ground water is encountered. When ground water is encountered, it too should be sampled. All samples should be analyzed for volatile organic compounds and total organic carbon.

5. The Northwest Landfill has a moderate potential for migration of contaminants beyond base boundaries. Monitoring of this site is recommended. The recommended monitoring includes three test bores, each drilled until ground water is encountered. One test bore should be drilled up gradient of expected ground water flow (west), one within the site, and one down gradient of expected ground water flow (east). Soil samples should be taken at ground level and at two foot intervals thereafter. When ground water is encountered, it too should be sampled. All samples should be analyzed for the parameters listed in Table 5.1 because of the variety of materials which might be encountered.

6. The East Ramp Fuel Spill has a moderately high potential for migration of contaminants beyond base boundaries. Monitoring of this site is recommended. The recommended monitoring includes three test bores, each drilled until ground water is encountered. One test bore should be drilled up

gradient of expected ground water flow (west), one within the site, and one down gradient of expected ground water flow (east). Soil samples should be taken at ground level and at two foot intervals thereafter. When ground water is encountered, it too should be sampled. All samples should be analyzed for volatile organic compounds and total organic carbon.

7. The Tucker Creek Landfill has a moderate potential for migration of contaminants beyond base boundaries. Monitoring of this site is recommended. The recommended monitoring includes three test bores, each drilled until ground water is encountered. One test bore should be drilled up gradient of expected ground water flow (west), one within the site, and one down gradient of expected ground water flow (east). Soil samples should be taken at ground level and at two foot intervals thereafter. When ground water is encountered, it too should be sampled. All samples should be analyzed for the parameters listed in Table 5.1.

In the event that follow-on studies are performed, it would be desireable to verify that no contamination exists where wastewater plant sludges were applied or waste oils were used for dust control. This could be accomplished economically in conjunction with a full Phase II study, but the potential for contamination of these sites does not justify a separate sampling program. The level of effort recommended would be to obtain three to six surficial soil samples (up to two feet deep) for analysis. The samples from the sludge disposal area would be analyzed for the parameters listed in Table 5.1. Samples from the West Perimeter Road should be analyzed for volatile organic compounds, phenol, and total organic carbon.

TABLE 5.1

Recommended List of Analytical Parameters

Volatile Organic Compounds
Chemical Oxygen Demand
Total Organic Carbon
Grease and Oil
Phenol
Cadmium
Chromium
Copper
Lead
Nickel
Zinc

APPENDIX A

BIOGRAPHICAL DATA

RESUME

John E. Schenk

PII Redacted [redacted]

[redacted]

EDUCATION

B.S.E.	Civil Engineering -- The University of Michigan --	1963
M.S.E.	Sanitary Engineering--The University of Michigan --	1964
Ph.D.	Civil Engineering - Water Resources The University of Michigan --	1969

PROFESSIONAL EXPERIENCE

1969 to Present

Environmental Control Technology Corporation
3983 Research Park Drive
Ann Arbor, Michigan 48104

Executive Vice-President: 1975 to present

Vice-President: 1973 - 1975

Associate: 1969 - 1973

1962 to Present

The University of Michigan
Ann Arbor, Michigan 48109

Adjunct Professor of Civil Engineering: 1979

Instructor in Civil Engineering: 1969 - 1973

Laboratory Assistant: 1962 - 1963
Sanitary Engineering Department

1968

Ayres, Lewis, Norris & May, Inc.
Ann Arbor, Michigan 48104

Advisory Consultant

1960

Atwell-Hicks Consulting Engineers, Ann Arbor, Michigan

Surveying

ROFESSIONAL SOCIETIES

National Society of Professional Engineers (Michigan)

American Society of Civil Engineers

American Water Works Association

Water Pollution Control Federation

HONOR SOCIETIES

Chi Epsilon

Tau Beta Pi

Phi Kappa Phi

Society of the Sigma Xi

REGISTRATION

Professional Engineer: State of Michigan

PROFESSIONAL PUBLICATIONS AND PRESENTATIONS

Schenk, John E. and Walter J. Weber, Jr., "Chemical Interactions of Dissolved Silica with Iron (II) and (III)". Journal American Water Works Association, February 1968.

Schenk, John Erwin, Ph.D., "Interactions of Monomeric Silica with Iron, Manganese, and Aluminum in Aqueous Solution". Dissertation, 1969.

Schenk, John E. and Walter J. Weber, Jr., "The Effects of Silica on Iron and Manganse in Natural Waters". Presented at American Chemical Society Meeting; New York City, New York, September 1969.

Schenk, John E., Peter G. Meier, Michael E. Bender, "Analysis of Pollution from Marine Engines - Status Report". 27th Annual Purdue Industrial Waste Conference, 1972.

Simon, Philip B. and John E. Schenk, "Refined Techniques for Monitoring Water Quality". Presented at the 165th national meeting of the American Chemical Society, Dallas, Texas, April 1973.

Bender, Michael E., Robert A. Jordan, and John E. Schenk, "Status of Outboard Marine Exhaust Research Project." Summer Symposium, Boating Industry Association, Lake Geneva, Wisconsin, June 1972.

Schenk, John E., et. al., "Effects of Outboard Marine Engine Exhaust on the Aquatic Environment". Presented at the Seventh Conference of the International Association on Water Pollution Research, Paris, 1974. Published in Progress in Water Technology, 1974.

Schenk, John E. and Dale A. Scherger, "The Affect of Residential and Commercial-Industrial Land Usage on Water Quality". Prepared for the Great Lakes Basin Commission. International Reference Group on Great Lakes Pollution from Land Use Activities. November, 1974.

Schenk, John E., "Chemical Oxidation". Presentation at IAWPR Short Course; University of Birmingham, 1974.

Simon, Philip B., and John E. Schenk, "A Refined Technique for Monitoring Lead and Cadmium in Water". Industrial Hygiene News Report, June 1973.

Environmental Control Technology Corporation, "Water Pollution Investigation: Detroit and St. Clair Rivers. U.S. E.P.A., December 1974.

Sanocki, S.L., P. B. Simon, R. L. Weitzel, D. E. Jerger, and J. E. Schenk, "Aquatic Field Surveys at Iowa Army Ammunition Plant" Prepared for the U.S. Army Medical R&D Command. November 1976.

Weitzel, R. L., R. C. Eisenman, and J. E. Schenk, "Aquatic Field Surveys for Radford Army Ammunition Plant." Prepared for U.S.A.M.R.&D. Command. November 1976.

Jerger, D.E., P. B. Simon, R. L. Weitzel, and J. E. Schenk, "Microbiological Investigations, Iowa and Joliet Army Ammunition Plants." Prepared for U.S.A.M.R.&D. Command. November 1976.

RESUME

Craig A. Morgan

[redacted]

[redacted]

EDUCATION

B.S. Biology -- Western Michigan University, 1977

M.S. Water Resources, Sci -- The University of Michigan, 1979

PROFESSIONAL EXPERIENCE

Oct., 1980 to Present

Environmental Control Technology Corporation
3983 Research Park Drive
Ann Arbor, Michigan 48104

Staff Scientist --

1. Storm Water Runoff Study: Supervision of field crews, data handling.
2. Industrial Waste Field Survey: Sampling, field analysis, data handling.
3. Industrial Waste Treatability Study.

PROFESSIONAL EXPERIENCE (Continued)

May, 1980 to Oct., 1980	Great Lakes Basin Commission 3475 Plymouth Road Ann Arbor, Michigan Planning Assistant -- Wrote Policy and Planning reports based on literature search.
Oct., 1978 to Dec., 1979	University of Michigan College of Engineering Ann Arbor, Michigan 48109 Research Assistant -- 1. Activated Carbon Adsorption. 2. Studies in PCB, PBB contamination in Lake Huron.
Aug., 1978 to Jan., 1979	Environmental Dynamics, Inc. 1254 North Main Ann Arbor, Michigan 48103 Research Chemist -- Applied research in hazardous waste removal by activated carbon.
Feb., 1976 to Apr., 1976	Western Michigan University Kalamazoo, Michigan Research Biologist -- Studied bulking in paper mill effluent due to bacterial action.

PUBLICATIONS

Morgan, Craig A. and Sonzogni, W.C., "Effect of Water Level Regulation on Water Quality in the Great Lakes," Great Lakes Environmental Planning Study, Great Lakes Basin Commission, Ann Arbor, Michigan.

Sonzogni, William C.; Morgan, C.A.; Heidthe, T.M.; Monteith, T.J. -- "Water Conservation Effects on Wastewater Treatment and Overall Water Quality of the Great Lakes," Great Lakes Environmental Planning Study, Great Lakes Basin Commission, Ann Arbor, Michigan.

Rev. 3/11/81

Resume of

Robert Charles Minning
6089 Skyline Drive
East Lansing, Michigan
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PII Redacted

[redacted]

Education

University of Toledo
Toledo, Ohio
M.S. in Geology/Hydrology, 1970

Indiana University
Bloomington, Indiana
M.A.T. in Earth Science, 1968

Wittenberg University
Springfield, Ohio
B.A. in Geology, 1965

Goethe Institute
Murnau, West Germany
Diploma in German, 1964

Lakewood High School
Lakewood, Ohio
Graduated June, 1960

Business Experience

1973-present — Keck Consulting Services, Inc.
Williamston, Michigan
President and Consulting Hydrogeologist

1970-present — W. G. Keck & Associates
East Lansing, Michigan
President

1970-72 — Lansing Community College
Lansing, Michigan
Instructor, Natural Science

1968-70 — University of Toledo
Toledo, Ohio
Graduate Teaching Assistant, Geology

1967-68 — Wittenberg University
School of Community Education
Instructor, Geology

1966-67	Wittenberg University Springfield, Ohio Assistant, Geology
Summer, 1967	Standard Oil of Ohio Cleveland, Ohio IBM 1401 Computer Operator
Summer, 1965	Standard Oil of Ohio Cleveland, Ohio IBM Accounting Machine Operator

Professional

Special Consultant in Hydrology, Pan American Health Organization/World Health Organization, Georgetown, Guyana and Port-au-Prince 1973-1977

Instructor in Geophysics for Short Course in Water Well Construction, Indian Health Service, Department of Health, Education and Welfare, Albuquerque, Arizona, 1979
Athens, Ohio, 1978
Yakima, Washington, 1976-77
Salem, Oregon, 1974-75
Tuscon, Arizona, 1973

Instructor in Hydrogeology for Technical Institute of Water Wells Design, University of Wisconsin-Extension, Madison, Wisconsin, 1976-present

Member, Editorial Board, GROUND WATER, 1976-79

Member, Editorial Board, Ground Water Monitoring Review, 1981 - present

Instructor in "Basic Hydrology for Well Drillers" Short Course, National Water Well Association, New Orleans, Louisiana, October 1975

Instructor in Geophysics, Short Course for Well Drillers, National Water Well Association, Columbus, Ohio, December, 1972

National Science Foundation Short Course to study Gulf Coast geology at Rice University, Houston, Texas, Summer 1967

Head Counselor, Men's Graduate Residence Hall, Indiana University, Bloomington, Indiana, 1965-66

Sports

Volleyball, basketball, skiing, tennis

Alternate, 1972 Men's Olympic Volleyball Team

First Alternate, 1967 U.S. Men's Pan American Volleyball Team

Professional Societies

National Water Well Association
American Water Works Association
Michigan Basin Geological Society
Association of Professional Geological Scientists
American Geophysical Union

Publications and Papers Presented

1981

"Contamination Study - Geophysical Techniques" paper presented at 6th Conference on Ground Water Contamination, East Lansing, Michigan, March 6, 1981.

1981

"The KECK Method of Computing Apparent Resistivity" with W. G. Keck and G. Henry, Jr., Ground Water Monitoring Review, Fall, 1981, pp. 64-68

1980

"Land and Groundwater Contaminants" paper presented at Symposium on Hazardous and Toxic Materials and their Disposal, Engineering Society of Detroit, April 22, 1980

1980

"The Ott/Story Chemical Company Case" paper presented with Mr. Gary R. Klepper, Michigan Department of Natural Resources at the Fifth National Groundwater Quality Symposium, Las Vegas, Nevada, October, 9, 1980

1978	"Ground Water Resource Management: Chemical Spills, Contaminants" paper presented at Annual Meeting, Michigan Section, American Water Works Association, Southfield, MI, September 27, 1978
1978	"Aquifer Performance Analyses" paper presented at Seminar on Principles and Applications of Ground Water Hydraulics, East Lansing, Michigan, February 10, 1978
1976-77	"Hydrogeologic and Geophysical Methods and Considerations for Locating Underground Water Supplies"
1975	"Ground Water Contamination" paper presented at Seminar on Principles and Applications of Ground Water Hydraulics, East Lansing, Michigan, February 13, 1975
1974	"The Cost of Geophysical Exploration" The Water Well Journal, v.28, No. 8
1973	"Effects of Ground Disposal of Sewage Sludge on Ground Water Supplies," paper presented at 34th Annual Meeting, Michigan Section, American Water Works Association, Grand Rapids, Michigan, September 13, 1973
	"The Earth Resistivity Method" The Water Well Journal, v. 27, Nos. 6 & 7
1972	"Drainage Hydrology of Land Disposal Sites," paper presented at Seminar on Principles and Applications of Ground Water Hydraulics, East Lansing,. Michigan, December 7, 1972, published in Symposium Proceedings
	"Aquifer Exploration and Development: Case Histories" paper presented at Seminar on Principles and Applications of Ground Water Hydraulics, East Lansing, Michigan, February 11, 1972

Resume of	Joseph W. Sheahan 1232 Haslett Rd. Haslett, Michigan 48840 (517) 339-1449
Personal	Height: 5'10" Weight: 150 lbs. Health: Excellent Marital Status: married
Education	University of Toledo Toledo, Ohio M.S. in Geology, December 1977 University of Toledo Toledo, Ohio B.S. in Geology, August 1975
Professional Experience	
1979-present	Keck Consulting Services, Inc. Williamston, Michigan --Hydrogeologist and Project Manager Work involves project preparation and report writing, field work including supervision, soil borings, monitor well installation, surveying, pump tests and surface water measurements.
1977-79	Mobil Oil Corp., Houston Exploration and Producing Division Houston, Texas --Geologist Duties included 18 months as a Production Geologist responsible for a 50-county area of Texas including well proposals and site selection, log analysis, well evaluations and completion. For 7 months was a member of Mobil's Texas Offshore Group, participating in the evaluation of tracts offered in two OCS sales and serving as Field Representative on one discovery well.
1975-77	University of Toledo Toledo, Ohio --Graduate Assistant Research assistant and teaching undergraduate laboratory sections.

1973-74	Stults and Associates Delaware, Ohio --Land Surveyor, Crew Chief Proficiency in the operation of Wild T-2 Theodolite, Hewlett-Packard Distance Meter, Zeiss Level, and the Transit. In charge of a six-week sewer design survey in Tiffin, Ohio.
1971-73	Michigan Testing, Inc. Toledo, Ohio --Technician Field and Lab Technician working in the testing and inspection of concrete, soils and structural steel.
Areas of <u>Special Interest</u>	Groundwater Hydrology Petroleum Geology Geophysics Surface Water Hydrology Environmental Geology Geotechnical Engineering
<u>Awards</u>	Sigma Gamma Epsilon National Geology Honorary Fraternity Gamma Eta Chapter - Secretary

JAMES F. BRAITHWAITE, P.E.

QUALIFICATIONS SUMMARY | PRINCIPAL

James Braithwaite is Executive Vice President of ECI, has been responsibly involved in sanitary and environmental engineering since 1967 and has the experience of working with a number of consulting engineering firms, a large municipal engineering department, and the engineering staff of the General Electric Company. Since joining the staff of Environmental Consultants, Inc., in 1972, he has been responsible for all solid waste management projects for the firm, for innovative design of wastewater treatment and water supply facilities, and for projects involving issues of risk to sensitive environments. His expertise lies in large measure with his familiarity with state and federal legislation and administrative procedures, and the needs of the regulatory agencies. Mr. Braithwaite is presently consultant to several municipal governments throughout Michigan in matters relating to facility siting and design, contamination of groundwaters, environmental regulation, and environmental assessment.

Mr. Braithwaite has been in responsible charge of all of ECI's hydrogeological investigations and environmental reviews and assessments. A specialist in environmental impact evaluation, he has projected the impacts of strip mining development on downstream recreational lakes; assessed the impacts of sanitary landfill activities on ground and surface water use and quality; and has been responsible for evaluating the impacts of the various methods of wastewater treatment and effluent disposal on lake, stream and groundwater environments. Past environmental assessment and water quality data collection projects include evaluation of the impacts of wastewater discharges into lakes of the Huron River Basin and the St. Clair River/Lake St. Clair systems, and evaluation of sludge disposal/utilization alternatives for the St. Clair region of Michigan. Mr. Braithwaite was project manager on a report funded by an Environmental Protection Agency grant, for the Southeast Michigan Council of Governments evaluating the technical feasibility and environmental impacts of land application of sludges from municipal treatment plants in the seven-county Southeast Michigan region.

He has also been in charge of the design and has served as project engineer in the design of several wastewater facilities, including facilities which incorporate tertiary treatment producing a stabilized effluent.

Current projects on which Mr. Braithwaite is serving as principal-in-charge include the site selection, design environmental assessment, and licensing of a sanitary landfill to serve the solid waste needs of a majority of Macomb County Michigan; and the investigation of wastewater treatment alternatives for two plan of study areas under the Clean Water Act -- Hayes Township, Clare County, Michigan and Dryden, Michigan. He has served as a technical consultant and expert witness including major participation in the Michigan Act 64 Site Approval Board review of the denied ERES Hazardous Waste Incinerator in Pontiac Township, Oakland County, and the ongoing review of the Stablex hazardous material processing facility and disposal site in Groveland Township, Oakland County, Michigan.

EDUCATION	B.S.E. - Michigan State University Post-Graduate Studies: Vanderbilt University (Environmental Engineering) and the University of Michigan (Hydrology and Water Resource Recovery
TECHNICAL SOCIETIES	Water Pollution Control Federation International Water Resources Association National Well Water Association Michigan Well Drillers Association, Technical Division
REGISTRATION	Professional Engineer in the States of Michigan and Arkansas

KATHERINE KING EVERETT

QUALIFICATIONS SUMMARY | ENVIRONMENTAL ENGINEER

Katherine Everett is one of the project engineers for ECI. While she is in charge of other staff members, she actively participates in the analysis and design of facilities and environmental assessments.

Ms. Everett's environmental engineering experience includes impact assessment of contaminants on streams and lakes, preparation of engineering reports, design of wastewater treatment facilities, water supply and distribution projects, and coordination of construction of treatment facilities. Ms. Everett's experience includes participation in the design and construction of groundwater discharge and land application systems, monitoring of groundwater and surface drainage of existing landfills, and the operations and maintenance of proper resource recovery and landfill management. Past environmental assessment activities have included evaluation of municipal wastewater discharges in Dryden and Croswell, Michigan, and environmental assessments of proposed landfill sites in Macomb and Lapeer counties. Ms. Everett is actively involved in all hazardous waste remedial clean-up projects handled by ECI and recently completed the hydraulic design of a purge well and treatment system for clean-up of groundwater contaminated with multiple organic compounds.

Katherine Everett has a strong background in chemistry, environmental impact assessment, industrial waste engineering, wastewater engineering, sanitary bacteriology, and chemical engineering. Since Ms. Everett joined the staff of Environmental Consultants, Inc., in 1979, she has been responsible for the investigation and preparation for ECI's environmental impact assessment projects.

EDUCATION	B.S. Environmental Engineering, Michigan Technological University
TECHNICAL SOCIETIES	American Society of Civil Engineers Water Pollution Control Federation Michigan Well Drillers Association, Groundwater Technology Division, Secretary/Treasurer
REGISTRATION	Michigan E.I.T., 1979

APPENDIX B

OUTSIDE AGENCY CONTACT LIST

NAME	ASSOCIATION	TITLE
Larry Moloney	Army Corps. of Engineers	Engineer
Robert Babcock	Mich DNR - Permits	Staff
Valerie Burgess	MDNR - Resource Recovery	Staff
Fred Rieth	MDNR - Air Quality - Pontiac	Staff
Cathy Morse Tim Jaske Roy Schramer	MDNR - District One Regional Office	Staff
Merlin Damon	Macomb County Env. Health Dept.	Sanitarial

APPENDIX C

INTERVIEW LIST

Selfridge ANGB

Interview List

Interview	Area of Knowledge	Years of Installation
1.	Public Works Officer	2
2.	Fuels Management	25
3.	Fuels Management	10
4.	DPDO	-
5.	Flight Line Maintenance	8
6.	Flight Line Maintenance	15
7.	Wing Administration	2
8.	Communications Maintenance	10
9.	Weather	15
10.	Recruiting	2
11.	Quality Assurance, Maintenance	10
12.	Quality Assurance	15
13.	Materials Control	1½
14.	Explosive Ordinance Disposal	9
15.	Unit Commander	2
16.	Flight Line Maintenance	13
17.	Operations	1
18.	Grounds Maintenance	2
19.	Grounds Maintenance	1
20.	Unit Administration	1½
21.	Operations and Maintenance	25
22.	Occupational Health	5
23.	Engineering and Construction	6
24.	Occupational Health	5
25.	Occupational Health	3
26.	Operations & Maintenance	27
27.	Heavy Equipment Operator	29

APPENDIX D

MASTER LIST OF SHOPS

SELFRIDGE ANGB MASTER SHOP LISTING

Det 1/Vehicle Operations & Maintenance
- Maintenance
- Motor Pool

Det 1/Director for Services
- Printing Shop

Det 1/Aircraft Maintenance
- Transient Alert

Coast Guard Air Station - Detroit
- Maintenance
- Metal Shop

Defense Property Disposal Office - Detroit
- Chief DPDO

Fleet Logistics Support Sq-VR52
- Maintenance

Ft Sheridan Fwd Area Spt Shop
- Maintenance
- Automotive

Health Services USA MEDDAC
- Occupational Health

Marine Wing Support Group 47
- Maintenance

Navl Air Facility Detroit
- Maintenance Control
- Public Works
- Hydraulic Shop
- Electric Shop

Patrol Squadron Ninety Three
- Maintenance Control

Serv-Air Incorporated
- Maintenance and Repair

US Army Aviation
- Maintenance and Supply

127 Tactical Fighter Wing
- Avionics
- Com Nav Maint
- Acft Ground Equip
- Corrosion Control
- Electrical Shop
- Fabrication
- Pneudraulic Shop
- Propulsion Shop
- Machine Shop

127 Tactical Fighter Wing (Cont'd)
- Sheet Metal
- Wheel/Tire Shop
- Maintenance Control
- Missile Maintenance

191 Fighter Interceptor Group
- Aircraft Maint
- Aerospace Equip
- Avionics
- Com-Nav Maint
- Fabrication
- Electric Shop
- Explosive Ord Disposal
- Machine Shop
- Maintenance Control
- Material Control
- Munitions
- Propulsion Shop
- Pneudraulic Shop
- Welding Shop

305 Rescue and Recovery Sqdn
- Aircraft Maint
- Aircraft Ground Equip
- Avionics Shop
- Electric Shop
- Engine Shop
- Hydraulic Shop
- Propeller Shop
- Sheet Metal Shop
- Weapons Shop

927 CAM Sq, AFRES
- Maintenance Control
- Material Control
- Corrosion Control
- Non-Destructive Insp
- Metal Shop
- Electric Shop
- Pneudraulics Shop
- Engine Shop
- Propeller Shop
- Support Equip Shop
- Radar Shop
- Radio Shop

2031 Communication Sq
- Maint Support
- Material Control
- Radar Maint
- Radio Maint

APPENDIX E

HAZARD ASSESSMENT RATING METHODOLOGY

USAF INSTALLATION RESTORATION PROGRAM
HAZARD ASSESSMENT RATING METHODOLOGY

BACKGROUND

The Department of Defense (DOD) has established a comprehensive program to identify, evaluate, and control problems associated with past disposal practices at DOD facilities. One of the actions required under this program is to:

> "develop and maintain a priority listing of contaminated installations and facilities for remedial action based on potential hazard to public health, welfare, and environmental impacts." (Reference: DEQPPM 81-5, 11 December 1981).

Accordingly, the United States Air Force (USAF) has sought to establish a system to set priorities for taking further actions at sites based upon information gathered during the Records Search phase of its Installation Restoration Program (IRP).

The first site rating model was developed in June 1981 at a meeting with representatives from USAF Occupational Environmental Health Laboratory (OEHL), Air Force Engineering Services Center (AFESC), Engineering-Science (ES) and CH_2M Hill. The basis for this model was a system developed for EPA by JRB Associates of McLean, Virginia. The JRB model was modified to meet Air Force needs.

After using this model for 6 months at over 20 Air Force installations, certain inadequacies became apparent. Therefore, on January 26 and 27, 1982, representatives of USAF OEHL, AFESC, various major commands, Engineering Science, and CH_2M Hill met to address the inadequacies. The result of the meeting was a new site rating model designed to present a better picture of the hazards posed by sites at Air Force installations. The new rating model described in this presentation is referred to as the Hazard Assessment Rating Methodology.

PURPOSE

The purpose of the site rating model is to provide a relative ranking of sites of suspected contamination from hazardous substances. This model will assist the Air Force in setting priorities for follow-on site investigations and confirmation work under Phase II of IRP.

This rating system is used only after it has been determined that (1) potential for contamination exists (hazardous wastes present in sufficient quantity), and (2) potential for migration exists. A site can be deleted from consideration for rating on either basis.

DESCRIPTION OF MODEL

Like the other hazardous waste site ranking models, the U.S. Air Force's site rating model uses a scoring system to rank sites for priority attention. However, in developing this model, the designers incorporated some special features to meet specific DOD program needs.

The model uses data readily obtained during the Record Search portion (Phase I) of the IRP. Scoring judgments and computations are easily made. In assessing the hazards at a given site, the model develops a score based on the most likely routes of contamination and the worst hazards at the site. Sites are given low scores only if there are clearly no hazards at the site. This approach meshes well with the policy for evaluating and setting restrictions on excess DOD properties.

As with the previous model, this model considers four aspects of the hazard posed by a specific site: the possible receptors of the contamination, the waste and its characteristics, potential pathways for waste contaminant migration, and any efforts to contain the contaminants. Each of these categories contains a number of rating factors that are used in the overall hazard rating.

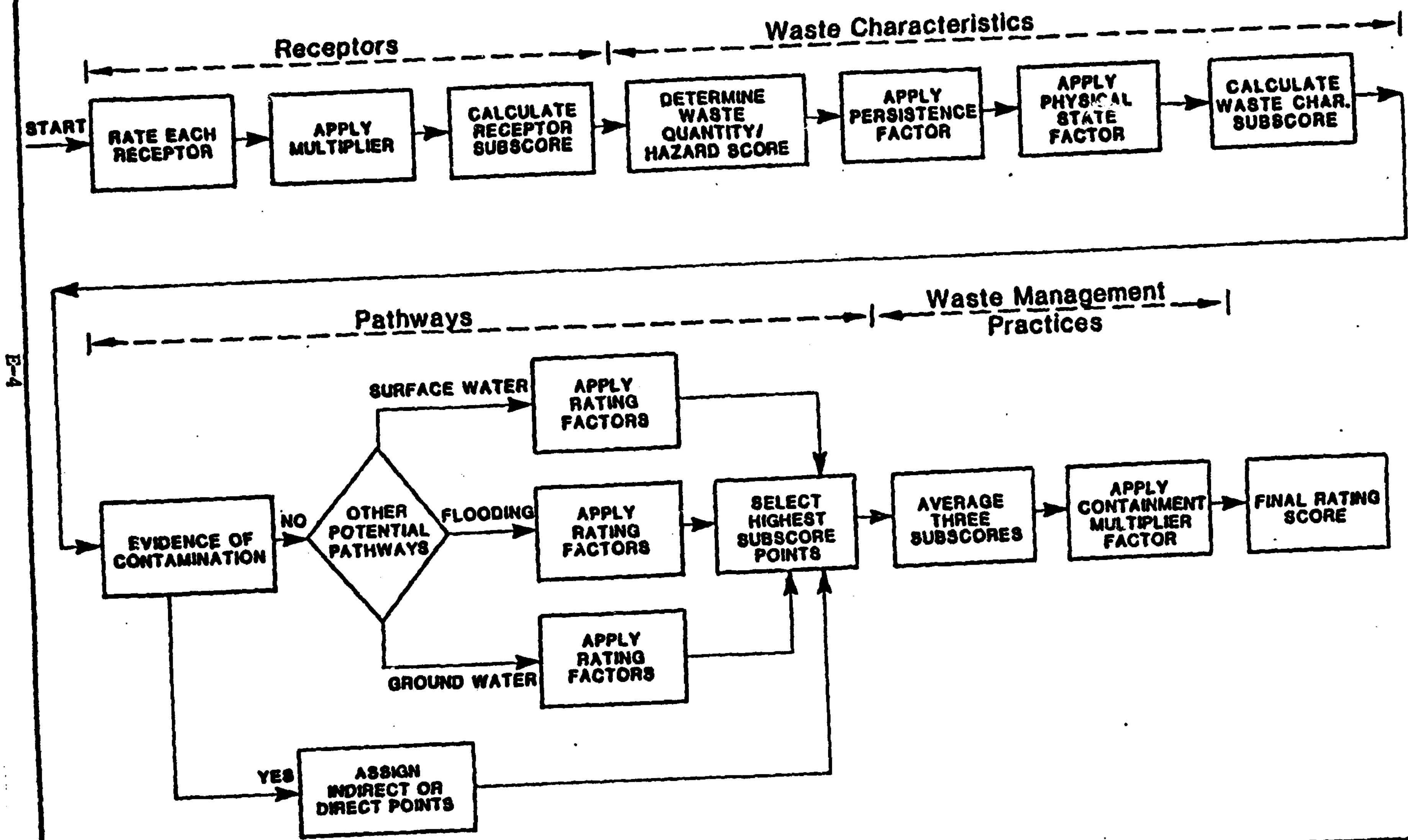
The receptors category rating is calculated by scoring each factor, multiplying by a factor weighting constant and adding the weighted scores to obtain a total category score.

The pathways category rating is based on evidence of contaminant migration or an evaluation of the highest potential (worst case) for contaminant migration along one of three pathways. If evidence of contaminant migration exists, the category is given a subscore of 80 to 100 points. For indirect evidence, 80 points are assigned and for direct evidence 100 points are assigned. If no evidence is found, the highest score among three possible routes is used. These routes are surface water migration, flooding, and ground-water migration. Evaluation of each route involves factors associated with the particular migration route. The three pathways are evaluated and the highest score among all four of the potential scores is used.

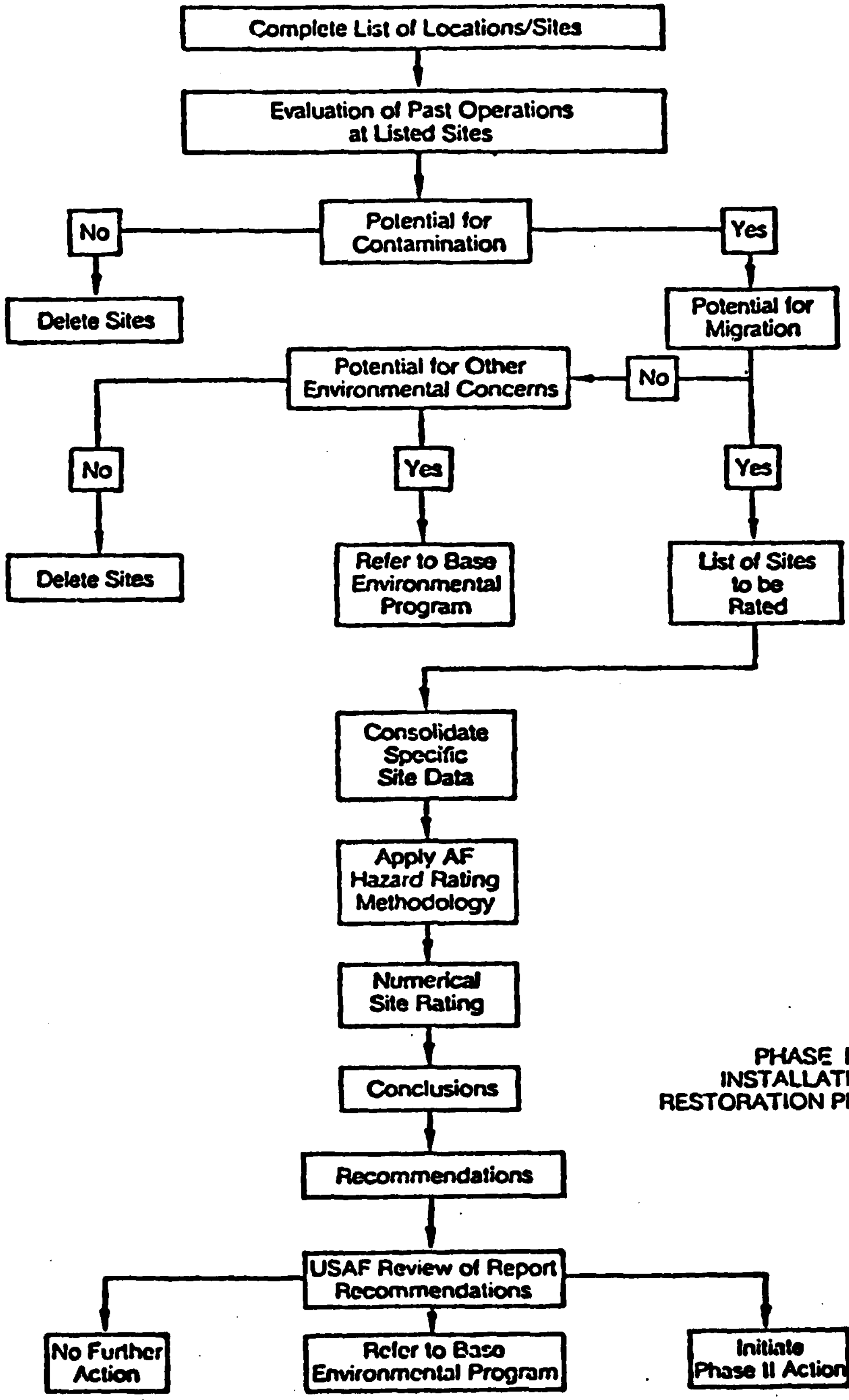
The waste characteristics category is scored in three steps. First, a point rating is assigned based on an assessment of the waste quantity and the hazard (worst case) associated with the site. The level of confidence in the information is also factored into the assessment. Next, the score is multiplied by a waste persistence factor, which acts to reduce the score if the waste is not very persistent. Finally, the score is further modified by the physical state of the waste. Liquid wastes receive the maximum score, while scores for sludges and solids are reduced.

The scores for each of the three categories are then added together and normalized to a maximum possible score of 100. Then the waste management practice category is scored. Sites at which there is no containment are not reduced in score. Scores for sites with limited containment can be reduced by 5 percent. If a site is contained and well managed, its score can be reduced by 90 percent. The final site score is calculated by applying the waste managment practices category factor to the sum of the scores for the other three categories.

HAZARD ASSESSMENT RATING METHODOLOGY FLOW CHART



DECISION TREE



PHASE I
INSTALLATION
RESTORATION PROGRAM

APPENDIX F

WASTE SITE RATING

Selfridge
Hazardous Assessment Rating Methodology

Notes:

1. "Potential for Flooding" scores based on exclusion of Base from 100-year floodplain by dike and levee system.

2. In Surface Water Migration rating, score for "Surface permeability" rated opposite of guidelines due to increased potential of surface-water contamination resulting from presence of permeable surface materials.

3. Receptors

Item G. Uppermost aquifer considered shallowest aquifer(s) in which area wells are screened.

Item I. Well log inventory only extends for one-mile radius yielding eleven well logs of record. Inferred use by more than 50 people within three-mile radius.

HAZARD ASSESSMENT RATING METHODOLOGY FORM

NAME OF SITE Southwest Landfill

LOCATION Selfridge ANGB, Southwest corner of base

DATE OF OPERATION OR OCCURRENCE ~ 1970 to 1980

OWNER/OPERATOR Selfridge ANGB

COMMENTS/DESCRIPTION

SITE RATED BY CAM, JWS, KKE

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	3	4	12	12
B. Distance to nearest well	3	10	30	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	0	10	0	30
F. Water quality of nearest surface water body	3	6	18	18
G. Ground water use of uppermost aquifer	2	9	18	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	2	6	12	18
Subtotals			114	180

Receptors subscore (100 X factor score subtotal/maximum score subtotal) 63.3

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) L
2. Confidence level (C = confirmed, S = suspected) C
3. Hazard rating (H = high, M = medium, L = low) H

Factor Subscore A (from 20 to 100 based on factor score matrix) 80

B. Apply persistence factor
Factor Subscore A X Persistence Factor = Subscore B

80 X 1.0 = 80

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

80 X 1.0 = 80

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore ______

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating, and proceed to C.

1. Surface water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Distance to nearest surface water	3	8	24	24
Net precipitation	2	6	12	18
Surface erosion	2	8	16	24
Surface permeability	3	6	18	18
Rainfall intensity	2	8	16	24
Subtotals			86	108

Subscore (100 X factor score subtotal/maximum score subtotal) 79.6

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
2. Flooding	0	1	0	30

Subscore (100 x factor score/3) 0

3. Ground-water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Depth to ground water	3	8	24	24
Net precipitation	2	6	12	18
Soil permeability	2	8	16	24
Subsurface flows	3	8	24	24
Direct access to ground water	2	8	16	24
Subtotals			92	114

Subscore (100 x factor score subtotal/maximum score subtotal) 80.7

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 80.7

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	63.3
Waste Characteristics	80
Pathways	80.7

Total 224 divided by 3 = 74.7 Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

74.7 x 1 = $\boxed{74.7}$

HAZARD ASSESSMENT RATING METHODOLOGY FORM

ME OF SITE Fire Training Area 2
CATION West of Taxiway C
TE OF OPERATION OR OCCURRENCE 1967 to present
NER/OPERATOR Selfridge ANGB
MMENTS/DESCRIPTION
TE RATED BY CAM, JWS, KKE

RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
. Population within 1,000 feet of site	3	4	12	12
. Distance to nearest well	3	10	30	30
. Land use/zoning within 1 mile radius	2	3	6	9
. Distance to reservation boundary	3	6	18	18
. Critical environments within 1 mile radius of site	0	10	0	30
. Water quality of nearest surface water body	3	6	18	18
. Ground water use of uppermost aquifer	2	9	18	27
. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
. Population served by ground-water supply within 3 miles of site	2	6	12	18
		Subtotals	114	180

Receptors subscore (100 X factor score subtotal/maximum score subtotal) 63.3

I. WASTE CHARACTERISTICS

. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) L
2. Confidence level (C = confirmed, S = suspected) C
3. Hazard rating (H = high, M = medium, L = low) H

Factor Subscore A (from 20 to 100 based on factor score matrix) 100

1. Apply persistence factor
Factor Subscore A X Persistence Factor = Subscore B

100 x 0.80 = 80

2. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

80 x 1.0 = 80

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore ______

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating, and proceed to C.

1. Surface water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Distance to nearest surface water	3	8	24	24
Net precipitation	2	6	12	18
Surface erosion	1	8	8	24
Surface permeability	3	6	18	18
Rainfall intensity	2	8	16	24
		Subtotals	76	108

Subscore (100 X factor score subtotal/maximum score subtotal) 72.2

2. Flooding

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Flooding	0	1	0	30

Subscore (100 x factor score/3) 0

3. Ground-water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Depth to ground water	3	8	24	24
Net precipitation	2	6	12	18
Soil permeability	2	8	16	24
Subsurface flows	1	8	8	24
Direct access to ground water	2	8	16	24
		Subtotals	76	114

Subscore (100 x factor score subtotal/maximum score subtotal) 66.7

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 72.2

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	63.3
Waste Characteristics	80
Pathways	72.2

Total 215.5 divided by 3 = 71.8 Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

71.8 x 1.0 = 71.8

HAZARD ASSESSMENT RATING METHODOLOGY FORM

AME OF SITE West Ramp Fuel Spill
OCATION Selfridge ANGB, West Ramp
ATE OF OPERATION OR OCCURRENCE Unknown, during the 1960's.
WNER/OPERATOR Selfridge ANGB
OMMENTS/DESCRIPTION Accidental fuel spill
ITE RATED BY CAM, JWS, KKE

RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
. Population within 1,000 feet of site	3	4	12	12
. Distance to nearest well	2	10	20	30
. Land use/zoning within 1 mile radius	2	3	6	9
. Distance to reservation boundary	2	6	12	18
. Critical environments within 1 mile radius of site	0	10	0	30
. Water quality of nearest surface water body	3	6	18	18
. Ground water use of uppermost aquifer	2	9	18	27
. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
. Population served by ground-water supply within 3 miles of site	2	6	12	18
		Subtotals	98	180

Receptors subscore (100 X factor score subtotal/maximum score subtotal) 54.4

. WASTE CHARACTERISTICS

. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) M
2. Confidence level (C = confirmed, S = suspected) C
3. Hazard rating (H = high, M = medium, L = low) H

Factor Subscore A (from 20 to 100 based on factor score matrix) 80

. Apply persistence factor
Factor Subscore A X Persistence Factor = Subscore B

80 x 0.8 = 64

. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

64 x 1.0 = 64

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 0

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating, and proceed to C.

1. Surface water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Distance to nearest surface water	3	8	24	24
Net precipitation	2	6	12	18
Surface erosion	0	8	0	24
Surface permeability	3	6	18	18
Rainfall intensity	1	8	8	24
		Subtotals	62	108

Subscore (100 X factor score subtotal/maximum score subtotal) 57.4

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
2. Flooding	0	1	0	30

Subscore (100 x factor score/3) 0

3. Ground-water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Depth to ground water	3	8	24	24
Net precipitation	2	6	12	18
Soil permeability	3	8	24	24
Subsurface flows	2	8	16	24
Direct access to ground water	2	8	16	24
		Subtotals	92	114

Subscore (100 x factor score subtotal/maximum score subtotal) 80.7

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 80.7

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	54.4
Waste Characteristics	64
Pathways	80.7

Total 199.1 divided by 3 = 66.4 Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

66.4 x 1.0 = 66.4

HAZARD ASSESSMENT RATING METHODOLOGY FORM

NAME OF SITE Fire Training Area 1

LOCATION East of Joy Road Gate

DATE OF OPERATION OR OCCURRENCE 1952-1967

OWNER/OPERATOR Selfridge ANGB

COMMENTS/DESCRIPTION

SITE RATED BY CAM, JWS, KKE

RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	3	4	12	12
B. Distance to nearest well	2	10	20	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	0	10	0	30
F. Water quality of nearest surface water body	3	6	18	18
G. Ground water use of uppermost aquifer	2	9	18	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	2	6	12	18
		Subtotals	104	180

Receptors subscore (100 X factor score subtotal/maximum score subtotal) 57.8

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) L
2. Confidence level (C = confirmed, S = suspected) C
3. Hazard rating (H = high, M = medium, L = low) H

Factor Subscore A (from 20 to 100 based on factor score matrix) 100

B. Apply persistence factor
Factor Subscore A X Persistence Factor = Subscore B

100 x 1.0 = 100

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

100 x 1.0 = 100

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 0

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating, and proceed to C.

1. Surface water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Distance to nearest surface water	3	8	24	24
Net precipitation	2	6	12	18
Surface erosion	0	8	0	24
Surface permeability	3	6	18	18
Rainfall intensity	2	8	16	24
Subtotals			70	108

Subscore (100 X factor score subtotal/maximum score subtotal) 64.8

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
2. Flooding	0	1	0	30

Subscore (100 x factor score/3) 0

3. Ground-water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Depth to ground water	3	8	24	24
Net precipitation	2	6	12	18
Soil permeability	2	8	16	24
Subsurface flows	1	8	8	24
Direct access to ground water	1	8	8	24
Subtotals			68	114

Subscore (100 x factor score subtotal/maximum score subtotal) 59.6

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 64.8

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	57.8
Waste Characteristics	100
Pathways	64.8

Total 222.6 divided by 3 = 74.2 Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

74.2 x 0.95 = 70.5

HAZARD ASSESSMENT RATING METHODOLOGY FORM

ME OF SITE East Ramp Fuel Spill

CATION East Ramp

TE OF OPERATION OR OCCURRENCE Unknown

NER/OPERATOR Selfridge ANGB

MMENTS/DESCRIPTION Accidental Fuel Spill

TE RATED BY CAM, JWS, KKE

RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
. Population within 1,000 feet of site	3	4	12	12
. Distance to nearest well	3	10	30	30
. Land use/zoning within 1 mile radius	2	3	6	9
. Distance to reservation boundary	2	6	12	18
. Critical environments within 1 mile radius of site	0	10	0	30
. Water quality of nearest surface water body	3	6	18	18
. Ground water use of uppermost aquifer	2	9	18	27
. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
. Population served by ground-water supply within 3 miles of site	2	6	12	18
		Subtotals	108	180

Receptors subscore (100 X factor score subtotal/maximum score subtotal) 60

I. WASTE CHARACTERISTICS

. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) M
2. Confidence level (C = confirmed, S = suspected) C
3. Hazard rating (H = high, M = medium, L = low) H

Factor Subscore A (from 20 to 100 based on factor score matrix) 80

1. Apply persistence factor
Factor Subscore A X Persistence Factor = Subscore B

80 x 0.8 = 64

2. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

64 x 1.0 = 64

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore ______

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating, and proceed to C.

1. Surface water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Distance to nearest surface water	3	8	24	24
Net precipitation	2	6	12	18
Surface erosion	0	8	0	24
Surface permeability	3	6	18	18
Rainfall intensity	2	8	16	24
		Subtotals	70	108

Subscore (100 X factor score subtotal/maximum score subtotal) 64.8

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
2. Flooding	0	1	3	0

Subscore (100 x factor score/3) 0

3. Ground-water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Depth to ground water	3	8	24	24
Net precipitation	2	6	12	18
Soil permeability	2	8	16	24
Subsurface flows	1	8	8	24
Direct access to ground water	2	8	16	24
		Subtotals	76	114

Subscore (100 x factor score subtotal/maximum score subtotal) 66.7

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 66.7

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	60
Waste Characteristics	64
Pathways	66.7

Total 182.2 divided by 3 = 60.7 Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

60.7 x 1.0 = 60.7

HAZARD ASSESSMENT RATING METHODOLOGY FORM

NAME OF SITE Northwest Landfill

LOCATION Northwest corner of base

DATE OF OPERATION OR OCCURRENCE ∿ 1956 to∿1978

OWNER/OPERATOR Selfridge ANGB

COMMENTS/DESCRIPTION

SITE RATED BY CAM, JWS, KKE

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	2	4	8	12
B. Distance to nearest well	3	10	30	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	0	10	0	30
F. Water quality of nearest surface water body	3	6	18	18
G. Ground water use of uppermost aquifer	2	9	18	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	2	6	12	18
		Subtotals	110	180

Receptors subscore (100 X factor score subtotal/maximum score subtotal) 61.1

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) L
2. Confidence level (C = confirmed, S = suspected) S
3. Hazard rating (H = high, M = medium, L = low) H

Factor Subscore A (from 20 to 100 based on factor score matrix) 70

B. Apply persistence factor
Factor Subscore A X Persistence Factor = Subscore B

70 x 0.9 = 63

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

63 x 1.0 = 63

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore ______

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating, and proceed to C.

1. Surface water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Distance to nearest surface water	3	8	24	24
Net precipitation	2	6	12	18
Surface erosion	1	8	8	24
Surface permeability	3	6	18	18
Rainfall intensity	2	8	16	24
Subtotals			78	108

Subscore (100 X factor score subtotal/maximum score subtotal) 72.2

2. Flooding

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Flooding	0	1	0	30

Subscore (100 x factor score/3) 0

3. Ground-water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Depth to ground water	3	8	24	24
Net precipitation	2	6	12	18
Soil permeability	2	8	16	24
Subsurface flows	3	8	24	24
Direct access to ground water	2	8	16	24
Subtotals			92	114

Subscore (100 x factor score subtotal/maximum score subtotal) 80.7

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 80.7

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	61.1
Waste Characteristics	63
Pathways	80.7

Total 204.8 divided by 3 = 68.3 Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

68.3 x 0.95 = $\boxed{64.9}$

HAZARD ASSESSMENT RATING METHODOLOGY FORM

ME OF SITE Tucker Creek Landfill

CATION East side of base; north of Bldg. 970

ATE OF OPERATION OR OCCURRENCE ∿ 1930 to ∿1955

NER/OPERATOR Selfridge ANGB

MMENTS/DESCRIPTION

TE RATED BY CAM, JWS, KKF

. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
. Population within 1,000 feet of site	3	4	12	12
. Distance to nearest well	1	10	10	30
. Land use/zoning within 1 mile radius	2	3	6	9
. Distance to reservation boundary	3	6	18	18
. Critical environments within 1 mile radius of site	0	10	0	30
. Water quality of nearest surface water body	3	6	18	18
. Ground water use of uppermost aquifer	2	9	18	27
. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
. Population served by ground-water supply within 3 miles of site	2	6	12	18
		Subtotals	94	180

Receptors subscore (100 X factor score subtotal/maximum score subtotal) 52.2

. WASTE CHARACTERISTICS

. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) L
2. Confidence level (C = confirmed, S = suspected) S
3. Hazard rating (H = high, M = medium, L = low) H

Factor Subscore A (from 20 to 100 based on factor score matrix) 70

. Apply persistence factor
Factor Subscore A X Persistence Factor = Subscore B

70 x 0.9 = 63

. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

63 x 1.0 = 63

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore ______

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating, and proceed to C.

1. Surface water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Distance to nearest surface water	3	8	24	24
Net precipitation	2	6	12	18
Surface erosion	1	8	8	24
Surface permeability	3	6	18	18
Rainfall intensity	2	8	16	24
		Subtotals	78	108

Subscore (100 X factor score subtotal/maximum score subtotal) 72.2

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
2. Flooding	0	1	0	30

Subscore (100 x factor score/3) 0

3. Ground-water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Depth to ground water	3	8	24	24
Net precipitation	2	6	12	18
Soil permeability	0	8	0	24
Subsurface flows	3	8	24	24
Direct access to ground water	1	8	8	24
		Subtotals	68	114

Subscore (100 x factor score subtotal/maximum score subtotal) 59.6

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 72.2

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	52.2
Waste Characteristics	63
Pathways	72.2

Total 187.4 divided by 3 = 62.5 Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

62.5 x 0.95 = 59.4

APPENDIX G

DIGESTED SLUDGE ANALYSIS

Metals Analysis

Digested Sludge

Lead	0.78	mg/l
Mercury	8.9	ug/l
Chromium, Total	0.25	mg/l
Chromium, Hexavalent	0.005	mg/l
Nickel	0.08	mg/l
Cadmium	0.065	mg/l
Zinc	4.2	mg/l
Copper	1.6	mg/l
Silver	0.21	mg/l
Cyanide	0.02	mg/l

APPENDIX H

PESTICIDE ANALYSES

August 31, 1979

Soil samples, sludge application area:

	#1	#2
DDT	287 ug/l	84.8 ug/l
DDE	79.6	57.6
Dieldrin	117	84.4
Chlordane	1285	1059

January 15, 1980

Water sample, pumphouse #508:

DDT	0.08 ug/l
DDE	0.14
Chlordane	1.08

April 10, 1980

Water sample, pumphouse #508:

DDE	0.79 ug/l
Chlordane	U

August 20, 1980

Soil sample, sludge application area:

DDE	K 10 ug/l
Chlordane	K 40

Water sample, pumphouse #507, #508, and #340:

	#507	#508	#340
DDT	K 0.02 ug/l	K 0.02 ug/l	0.21 ug/l
DDE	K 0.02	K 0.02	0.07
Chlordane	K 0.1	K 0.1	K 0.1

K = less than limit of detection
U = undetected

APPENDIX I

GLOSSARY

GLOSSARY OF TERMINOLOGY AND ABBREVIATIONS

AFB: Air Force Base

ANG: Air National Guard

ANGB: Air National Guard Base

ARTESIAN: Groundwater contained under hydrostatic pressure

AQUIFER: A geologic formation, group of formations, or part of a formation that is capable of yielding water to a well or spring

AVGAS: Aviation gasoline

BGL: Below ground level

CAM: Consolidated Aircraft Maintenance

CERCLA: Comprehensive Environmental Response, Compensation and Liability Act

CES: Civil Engineering Squadron

COD: Chemical Oxygen Demand, a measure of the amount of oxygen required to oxidize organic and oxidizable inorganic compounds in water

CONTAMINATION: The degradation of natural water quality to the extent that its usefulness is impaired; there are no implications of any specific limits because the degree of permissible contamination depends upon the intended end use or uses of the water

DET: Detachment

DISPOSAL FACILITY: A facility or part of a facility at which hazardous waste is intentionally placed into or on land or water, and at which waste will remain after closure

DISPOSAL OF HAZARDOUS WASTE: The discharge, deposit, injection, dumping, spilling, or placing of any hazardous waste into or on land or water so that such waste or any constituent thereof may enter the environment or be emitted into the air or discharged into any waters, including groundwater

DOD: Department of Defense

DOWN-GRADIENT: In the direction of decreasing hydraulic static head; the direction in which groundwater flows

DPDO: Defense Property Disposal Office, previously included R & M, Redistribution and Marketing

DUMP: An uncovered land disposal site where solid and/or liquid wastes are deposited with little or no regard for pollution control or aesthetics; dumps are susceptible to open burning and are expose to the elements, disease vectors, and scavengers

EOD: Explosive Ordnance Disposal

EFFLUENT: A liquid waste discharge from a manufactu- ıg or treatment process, in its natural state, or parti 'y or completely treated, that discharges into the environm

EPA: U.S. Environmental Protection Agency

EROSION: The wearing away of land surface by wind or water

FLOOD PLAIN: The lowland and relatively flat areas adjoining inland and coastal areas of the mainland and off-shore islands, including, at a minimum, areas subject to a one percent or greater chance of flooding in any given year

FLOW PATH: The direction or movement of groundwater and any contaminants that may be contained therein, as governed principally by the hydraulic gradient

FTA: Fire Training Area

GROUNDWATER: Water beneath the land surface in the saturated zone that is under atmospheric or artesian pressure

HARM: Hazardous Assessment Rating Methodology

HAZARDOUS WASTE: A solid waste, or combination of solid wastes, which because of its quantity, concentration, or physical, chemical or infectious characteristics may cause or significantly contribute to any increase in mortality or an increase in serious, irreversible, or incapacitating reversible illness; or pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed

HAZARDOUS WASTE GENERATION: The act or process of producing a hazardous waste

HEAVY METALS: Metallic elements, including the transition series, which include many elements required for plant and animal nutrition in trace concentrations but which become toxic at higher concentrations

INCOMPATIBLE WASTE: A waste unsuitable for commingling with another waste or material because the commingling might result in generation of extreme heat or pressure, explosion or violent reaction, fire, formation of substances which are shock sensitive, friction sensitive, or otherwise have the potential for reacting violently, formation of toxic dusts, mists, fumes, and gases, volatilization or ignitable or toxic chemicals due to heat generation in such a manner that the likelihood of contamination of groundwater or escape of the substance into the environment is increased, any other reaction which might result in not meeting the Air, Human Health, and Environmental Standard

INFILTRATION: The flow of liquid through pores or small openings

IRP: Installation Restoration Program

JP-4: Jet Fuel

LEACHATE: A solution resulting from the separation or dissolving of soluble or particulate constituents from solid waste or other man-placed medium by percolation of water

LEACHING: The process by which soluble materials in the soil, such as nutrients, pesticide chemicals, or contaminants, are washed into a lower layer of soil or are dissolved and carried away by water

LINER: A continuous layer of natural or man-made materials beneath or on the sides of a surface impoundment, landfill, or landfill cell which restricts the downward or lateral escape of hazardous waste, hazardous waste constituents, or leachate

MDNR: Michigan Department of Natural Resources

MSL: Mean sea level

RCRA: Resource Conservation and Recovery Act

SLUDGE: The solid residue resulting from a manufacturing or wastewater treatment process which also produces a liquid stream

SOLID WASTE: Any garbage, refuse, or sludge from a waste treatment plant, water supply treatment, or air pollution control facility and other discarded material, including solid, liquid, semi-solid, or contained gaseous material resulting from industrial, commercial, mining, or agricultural operations and from community activities, but does not include solid or dissolved materials in domestic sewage; solid or dissolved materials in irrigation return flows; industrial discharges which are point source subject to permits under Section 402 of the Federal Water Pollution Control Act, as amended (86 USC 880); or source, special nuclear, or by-product material as defined by the Atomic Energy Act of 1954 (68 USC 923)

SPILL: Any unplanned release or discharge of a hazardous waste onto or into the air, land or water

STORAGE OF HAZARDOUS WASTE: Containment, either on a temporary basis or for a longer period, in such a manner as not to constitute disposal of such hazardous waste

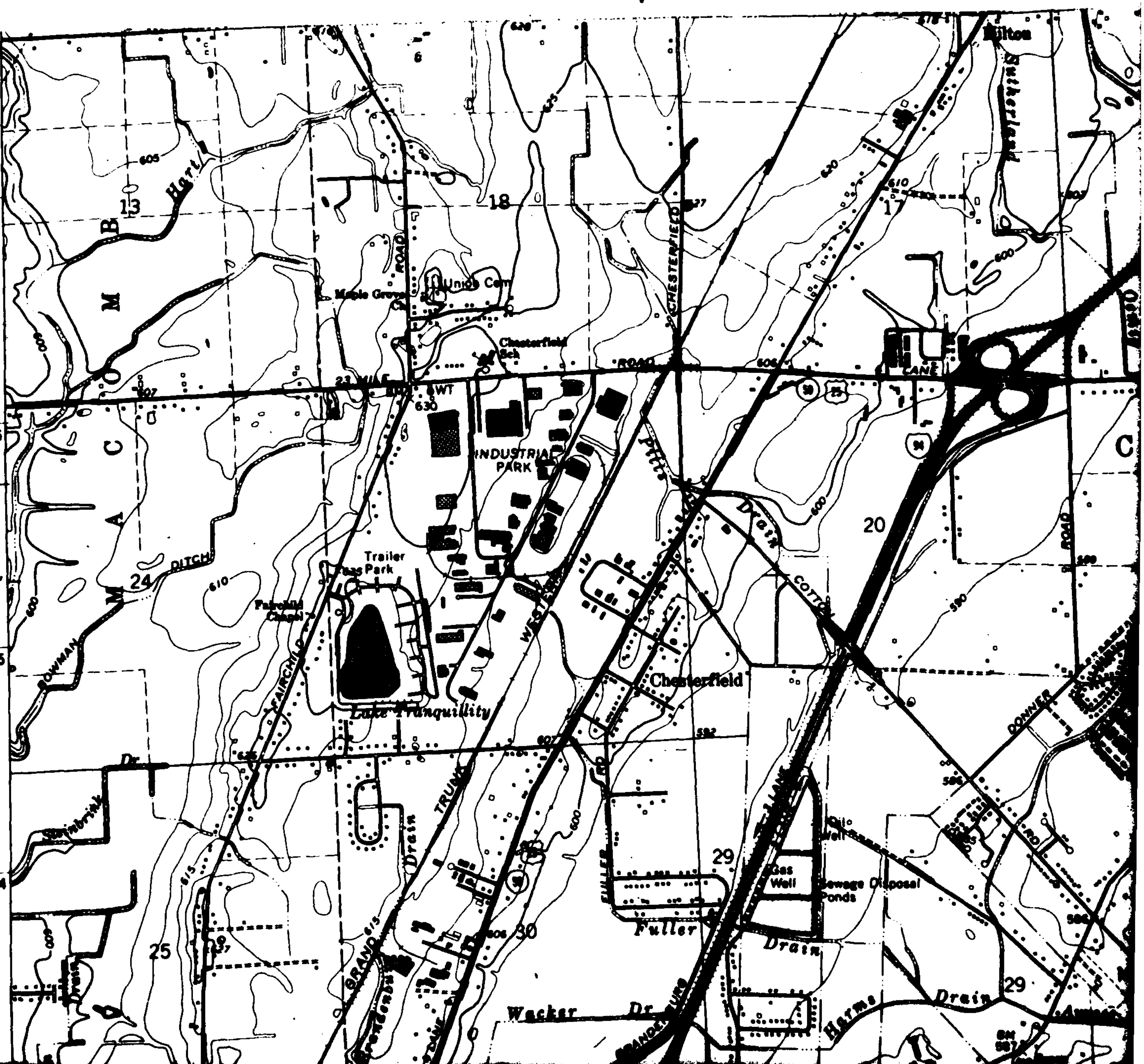
TOXICITY: The ability of a material to produce injury or disease upon exposure, ingestion, inhalation, or assimilation by a living organism

TREATMENT OF HAZARDOUS WASTE: Any method, technique, or process including neutralization designed to change the physical, chemical, or biological character or composition of any hazardous waste so as to neutralize the waste or so as to render the waste nonhazardous

UP-GRADIENT: In the direction of increasing hydraulic static head; the direction opposite to the prevailing flow of groundwater

WATERLAID MORAINE: An accumulation of earth and stones carried and deposited by water, as opposed to the more commonly referred to glacial moraine

WATER TABLE: Surface of a body of unconfined groundwater at which the pressure is equal to that of the atmosphere



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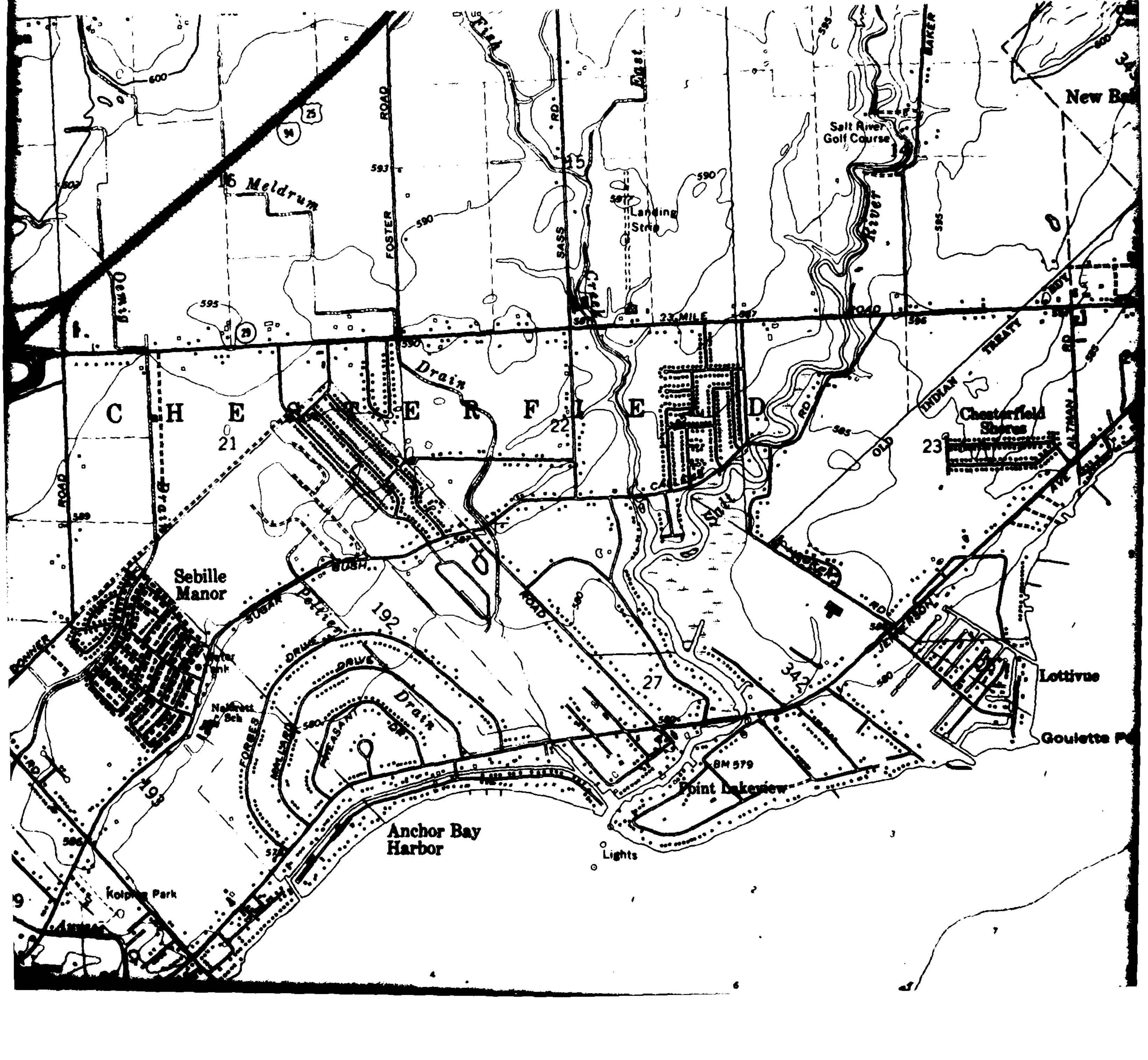

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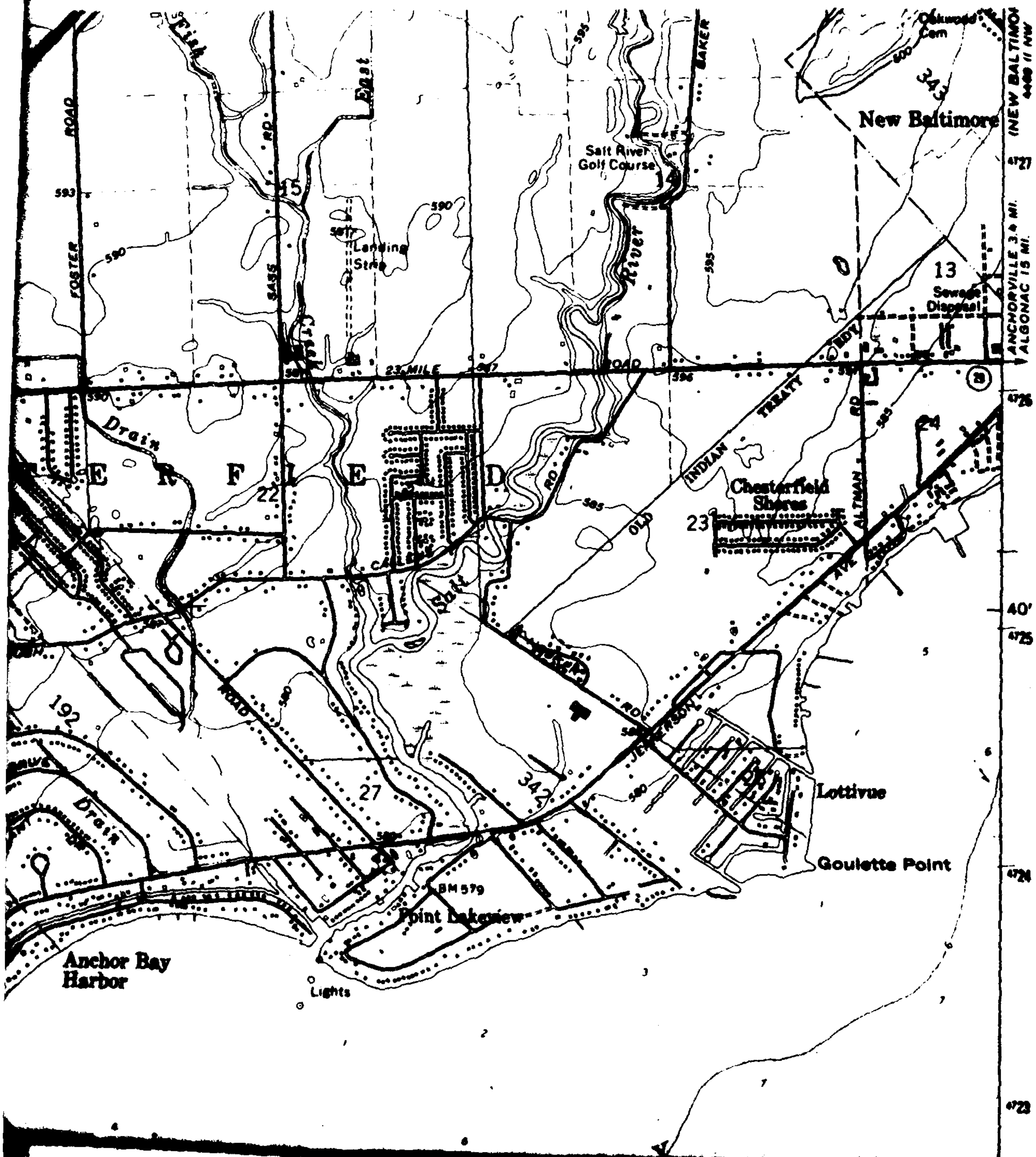
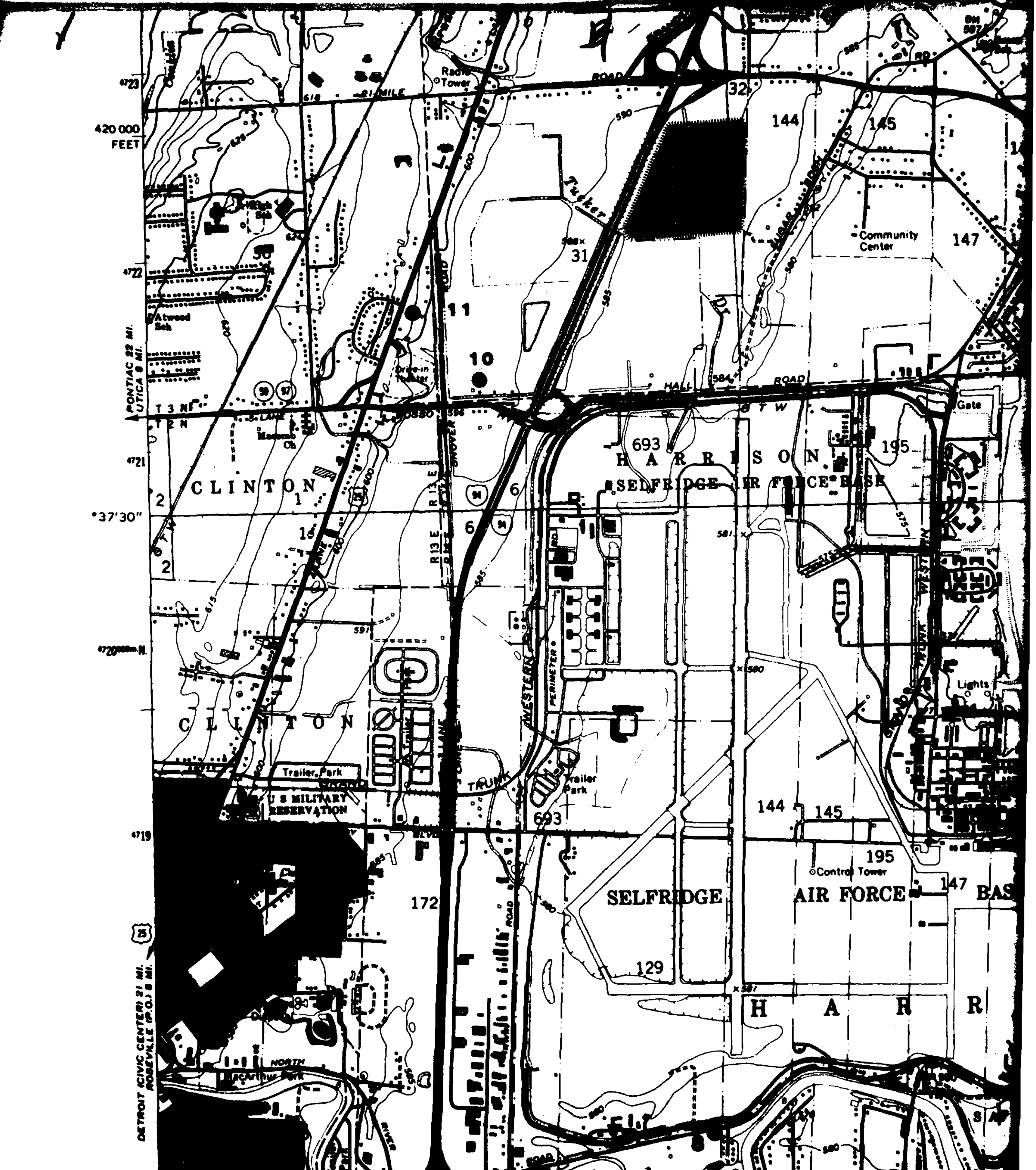
PLATE I





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195
Control Tower
147
SELFRIDGE AIR FORCE BASE
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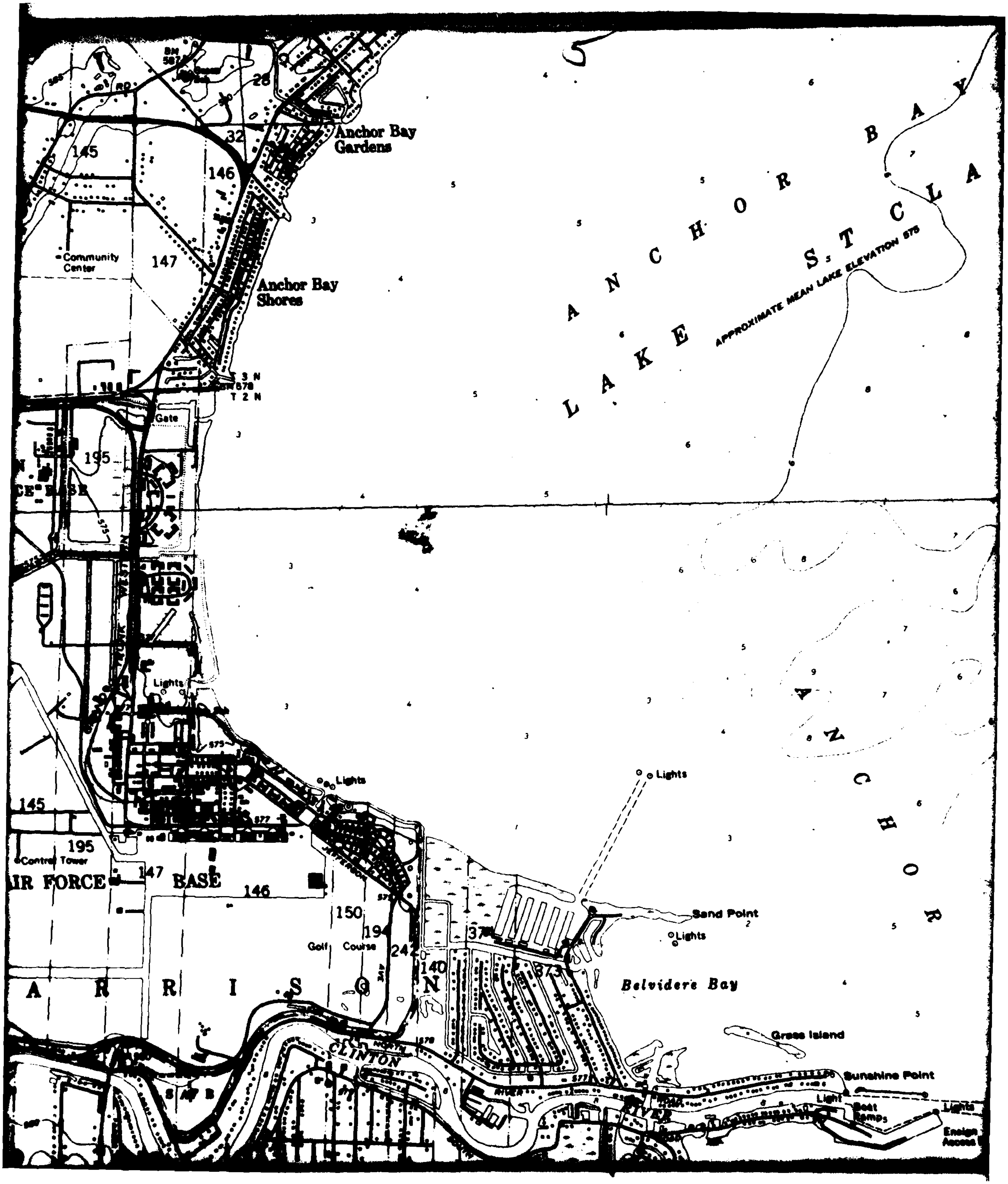
NORTH
McArthur Park
DETROIT (CIVIC CENTER) 21 MI.
ROSEVILLE (P.O.) 8 MI.
25
ROAD



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Anchor Bay Shores
Community Center
ANCHOR BAY
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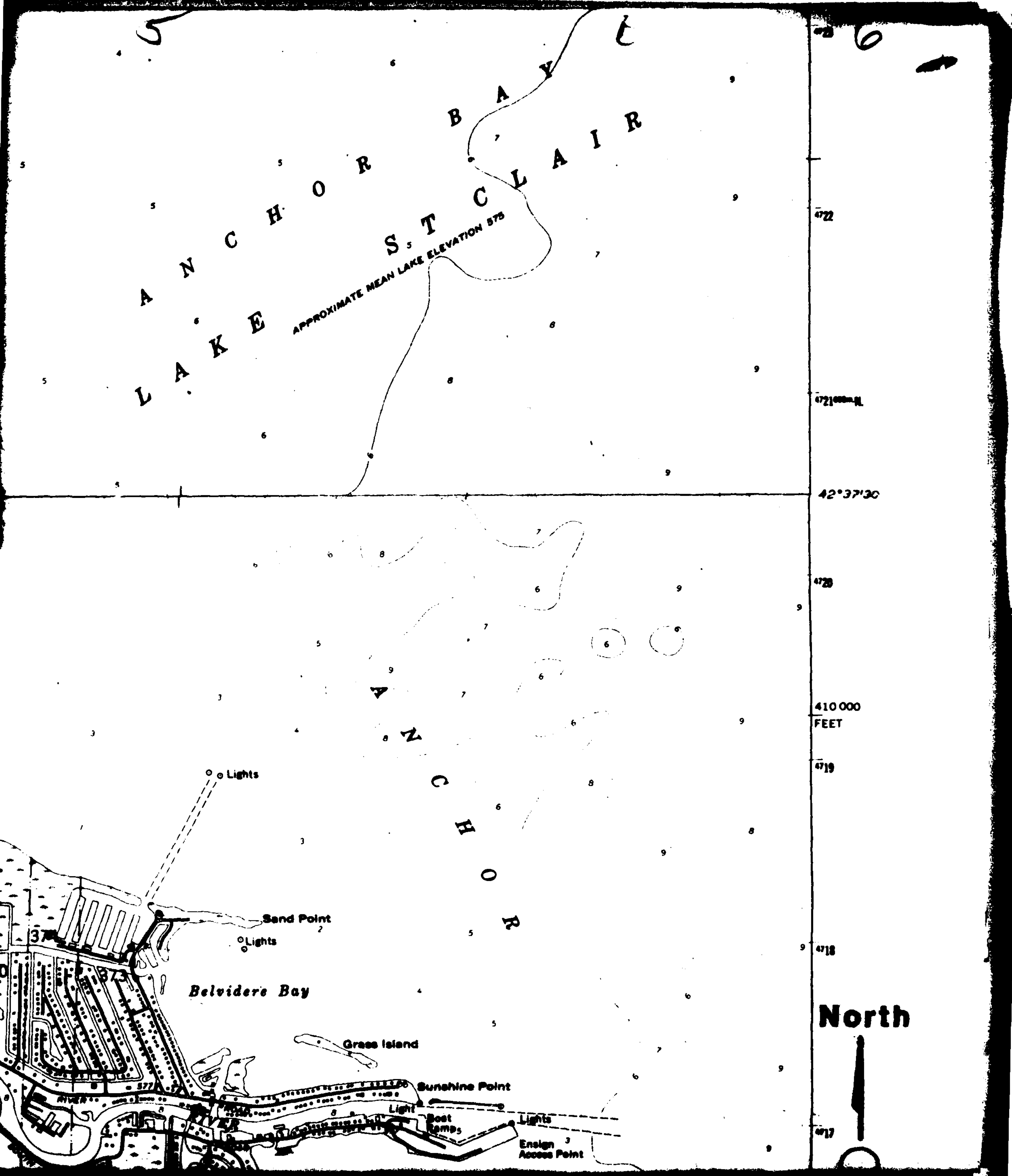
Gate
Lights
Control Tower
AIR FORCE BASE
Golf Course
ARRISON
ANCHOR
Sand Point
Belvidere Bay
Grass Island
Sunshine Point
Boat Ramps
CLINTON



ANCHOR BAY
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APPROXIMATE MEAN LAKE ELEVATION 575
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ANCHOR
Lights
Sand Point
Lights
Belvidere Bay
Grass Island
Sunshine Point
Light
Boat Ramps
Lights
Ensign Access Point
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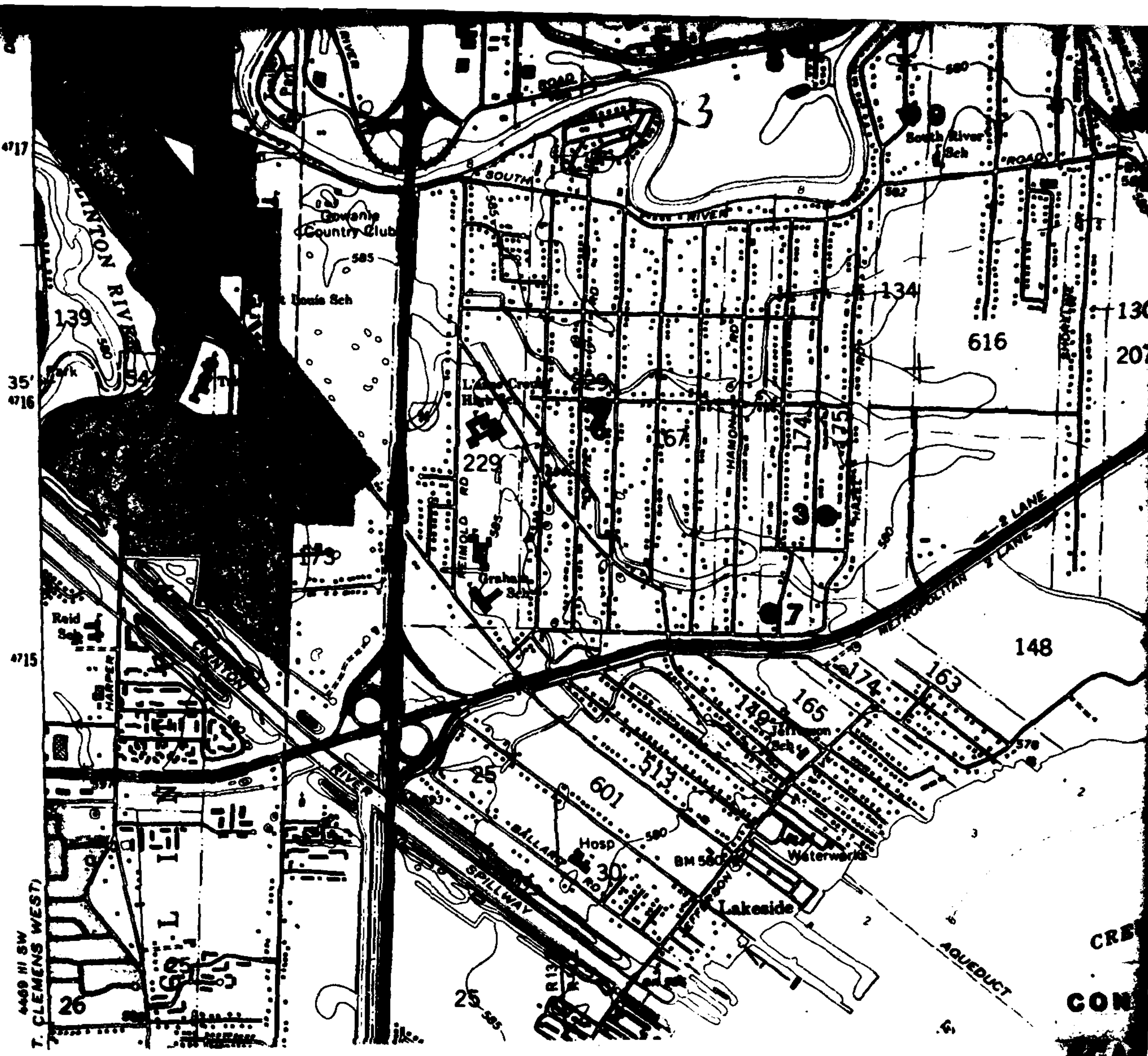
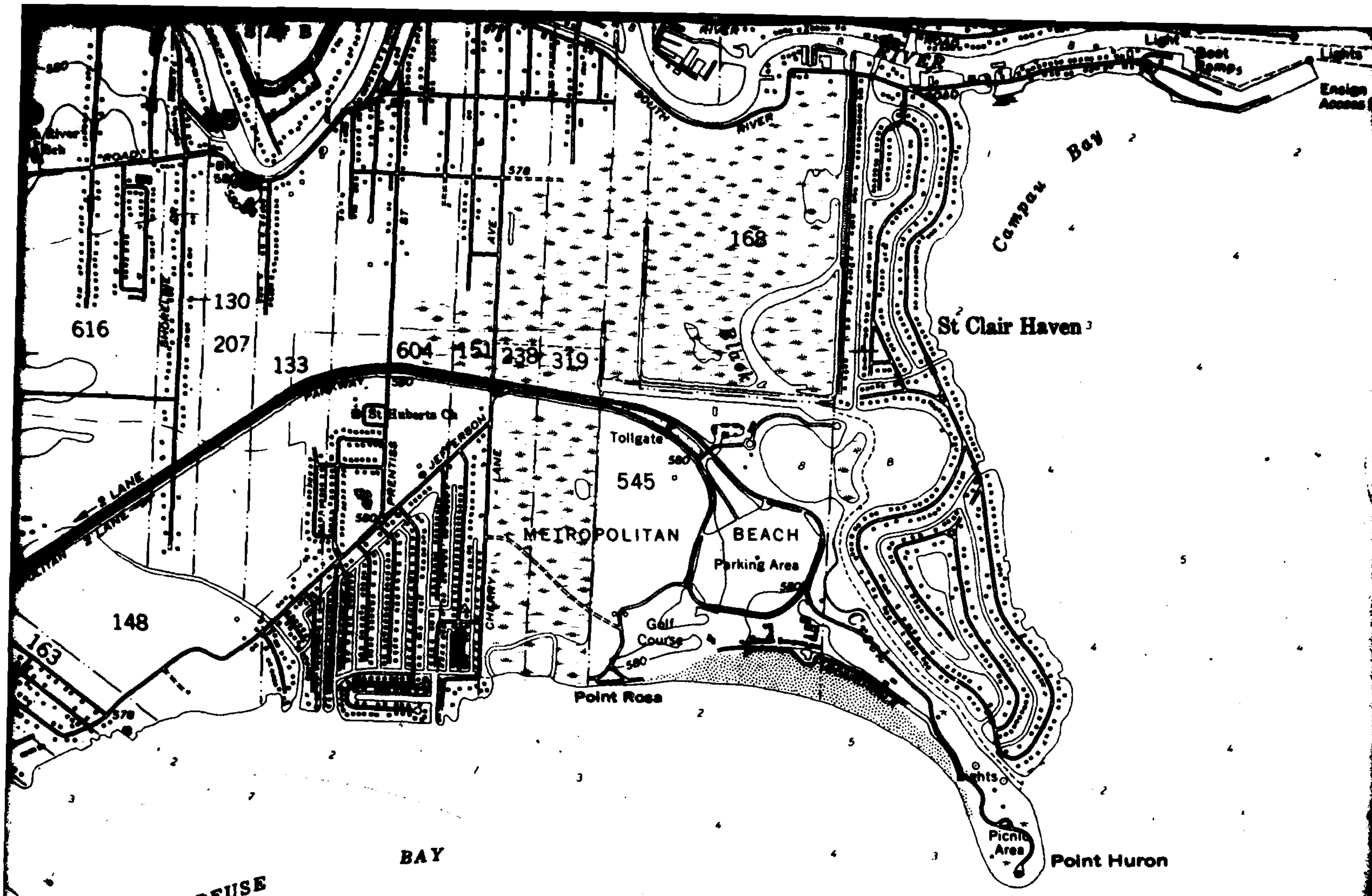
4717
North

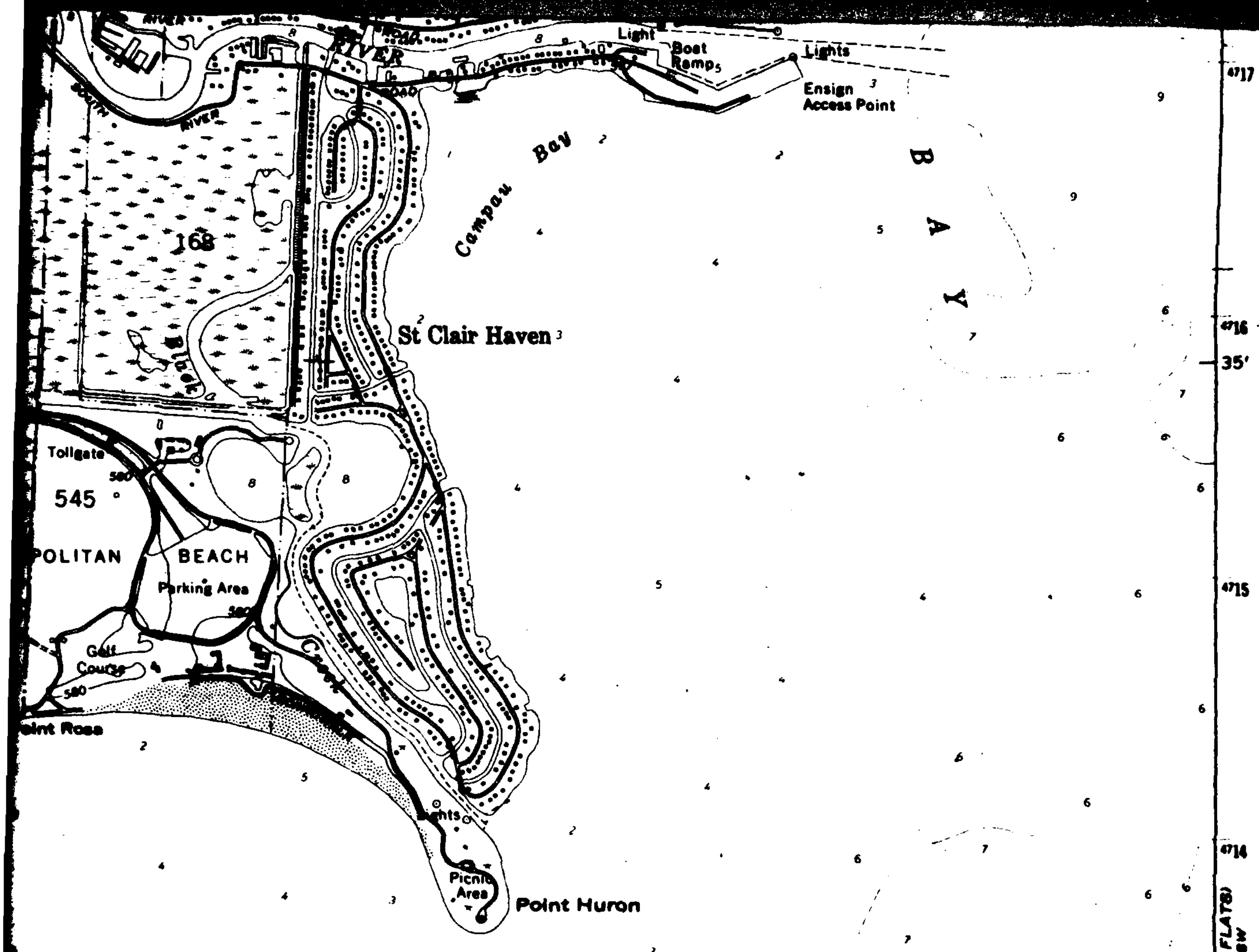


ADAPTED FROM USGS TOPOGRAPHIC QUADS MOUNT CLEMENS EAST & NEW HAVEN.

67



SELFRIDGE AIR NATIONAL GUAR
SITE LOCATION , AREA TOPOGR
DRAINAGE AND DOMESTIC WEL



SELFRIDGE AIR NATIONAL GUARD BASE
SITE LOCATION , AREA TOPOGRAPHY ,
DRAINAGE AND DOMESTIC WELL LOCATIONS

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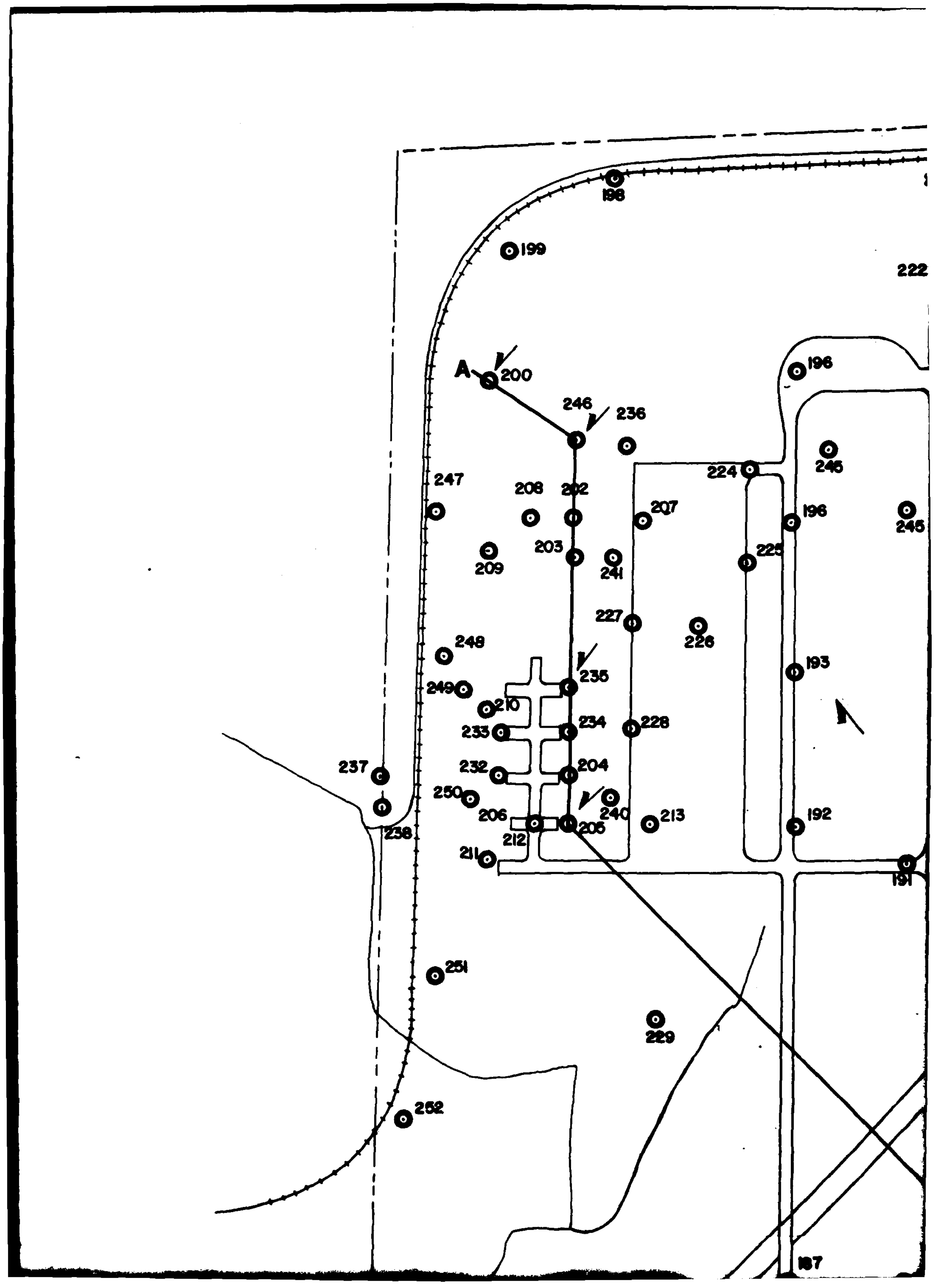

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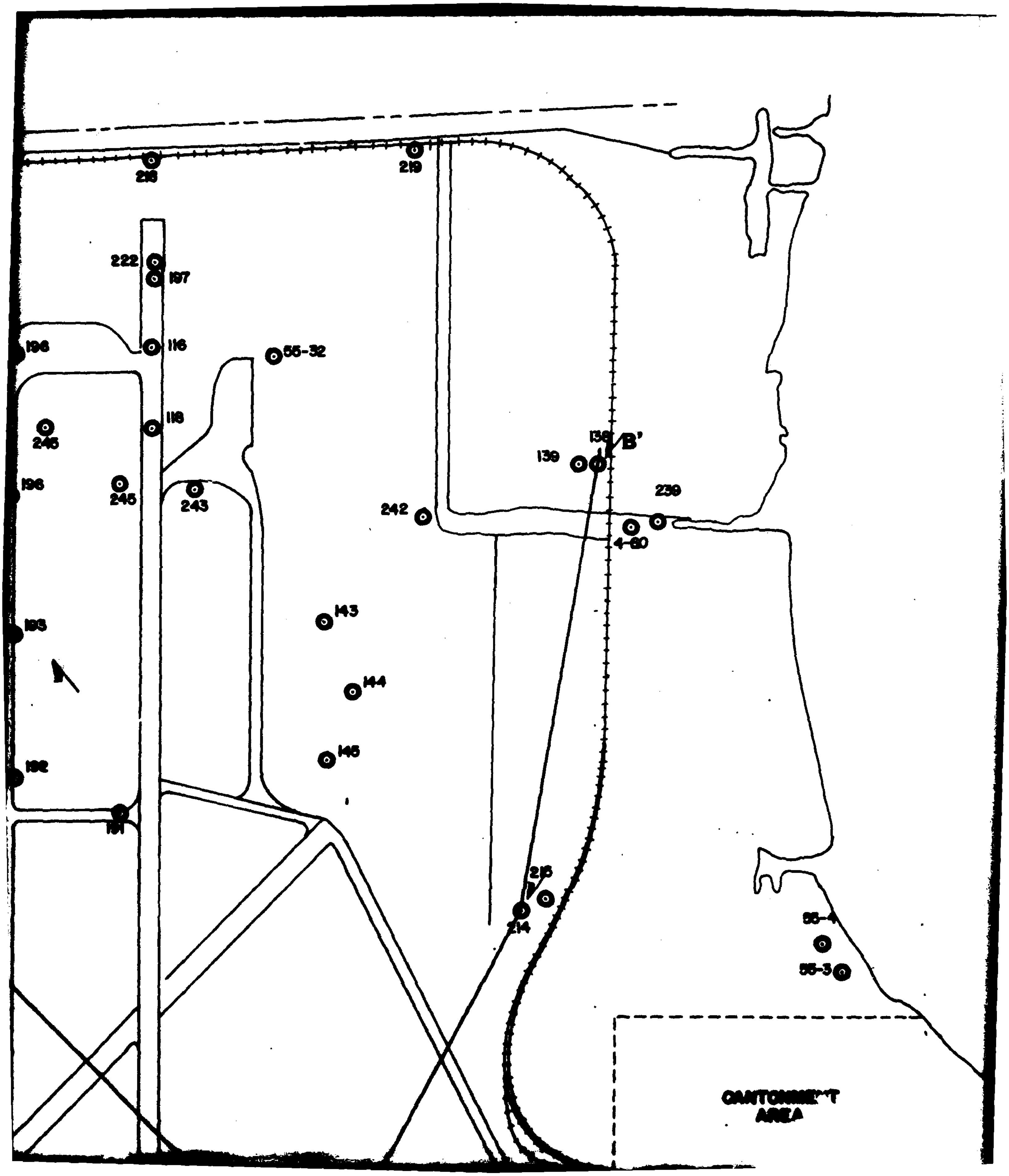

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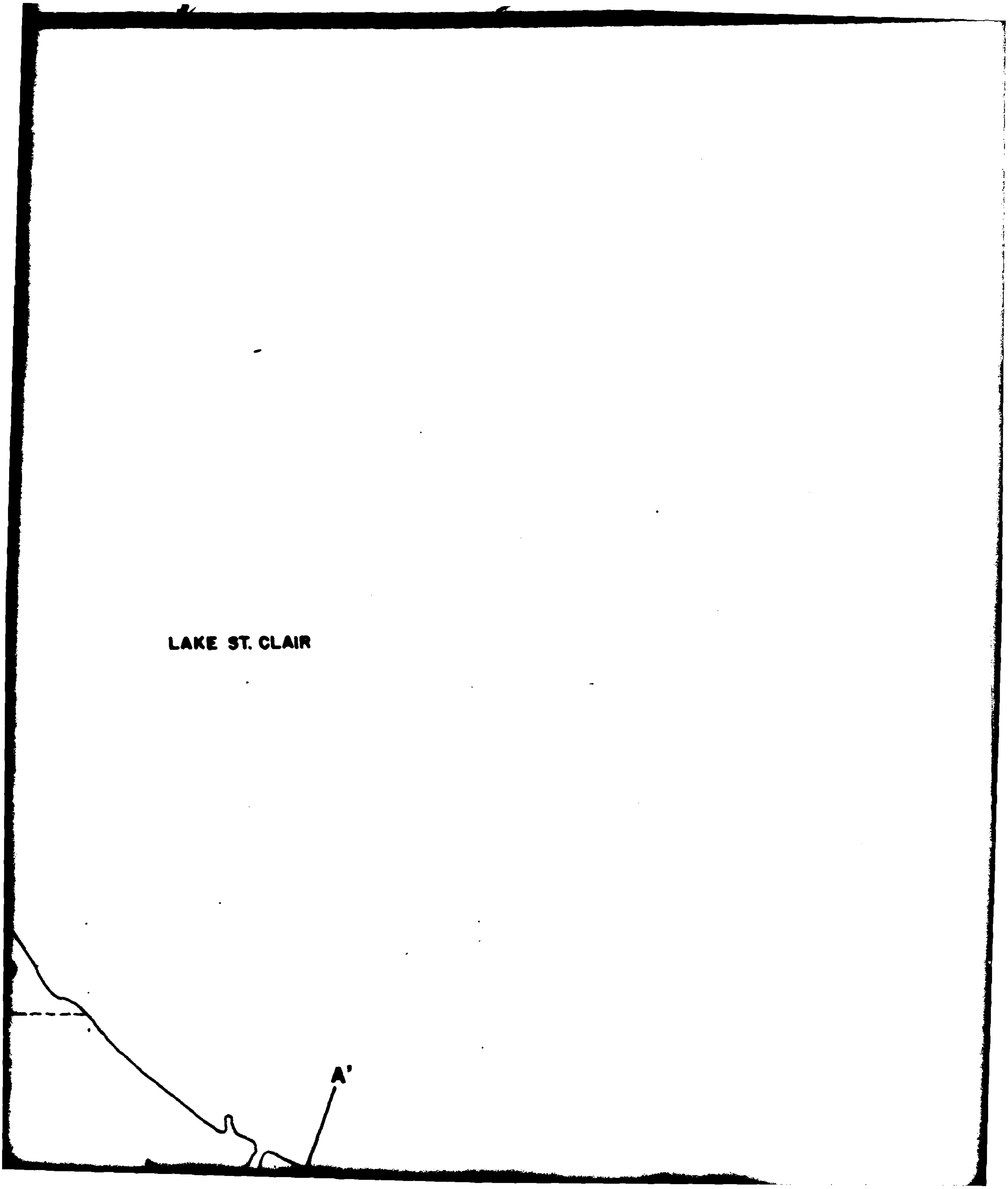
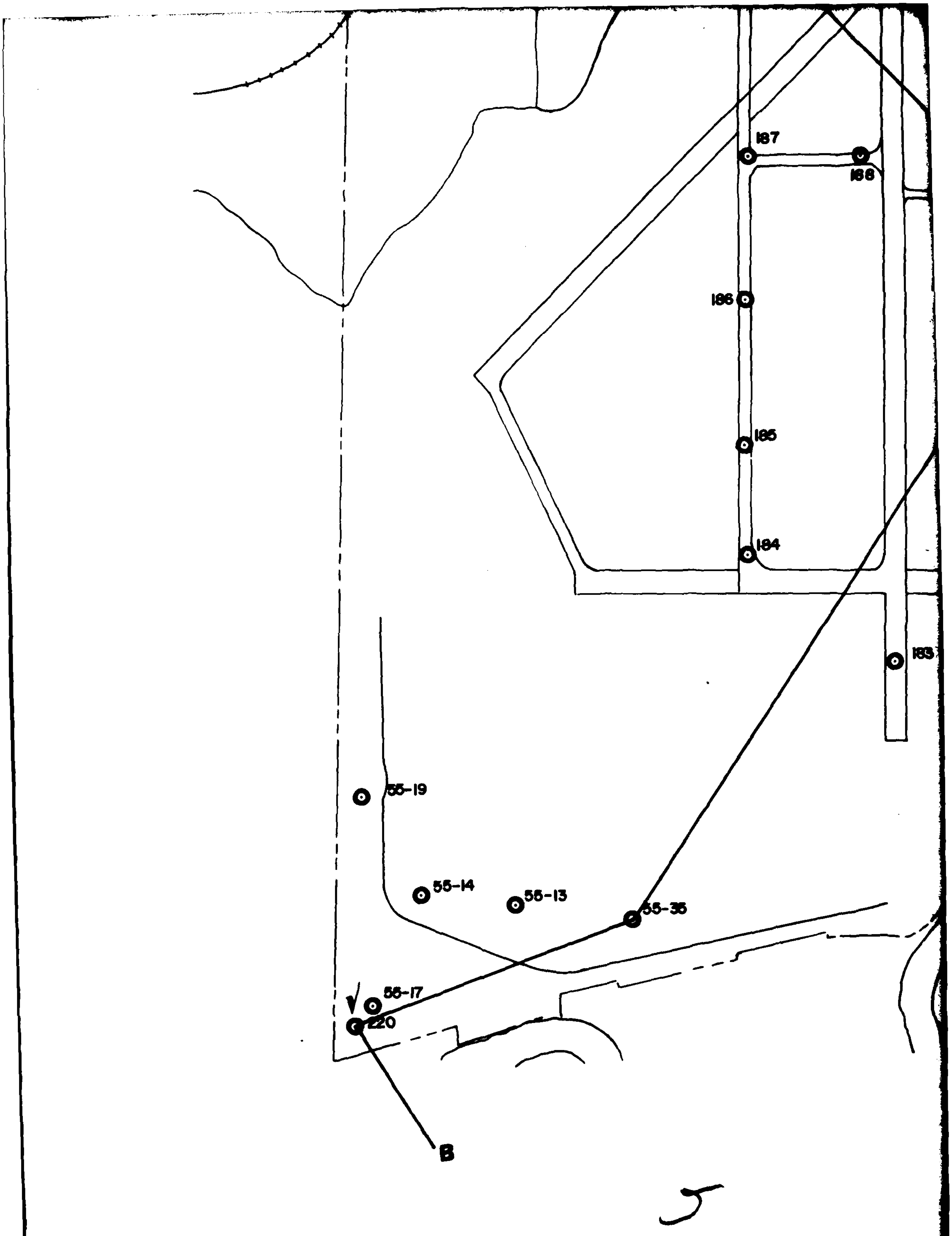

LAKE ST. CLAIR
A'

SELFRIDGE AIR FORCE BASE

MT. CLEMENS MICHIGAN

SOIL BORING AND CROSS SECTION LOCATION MAP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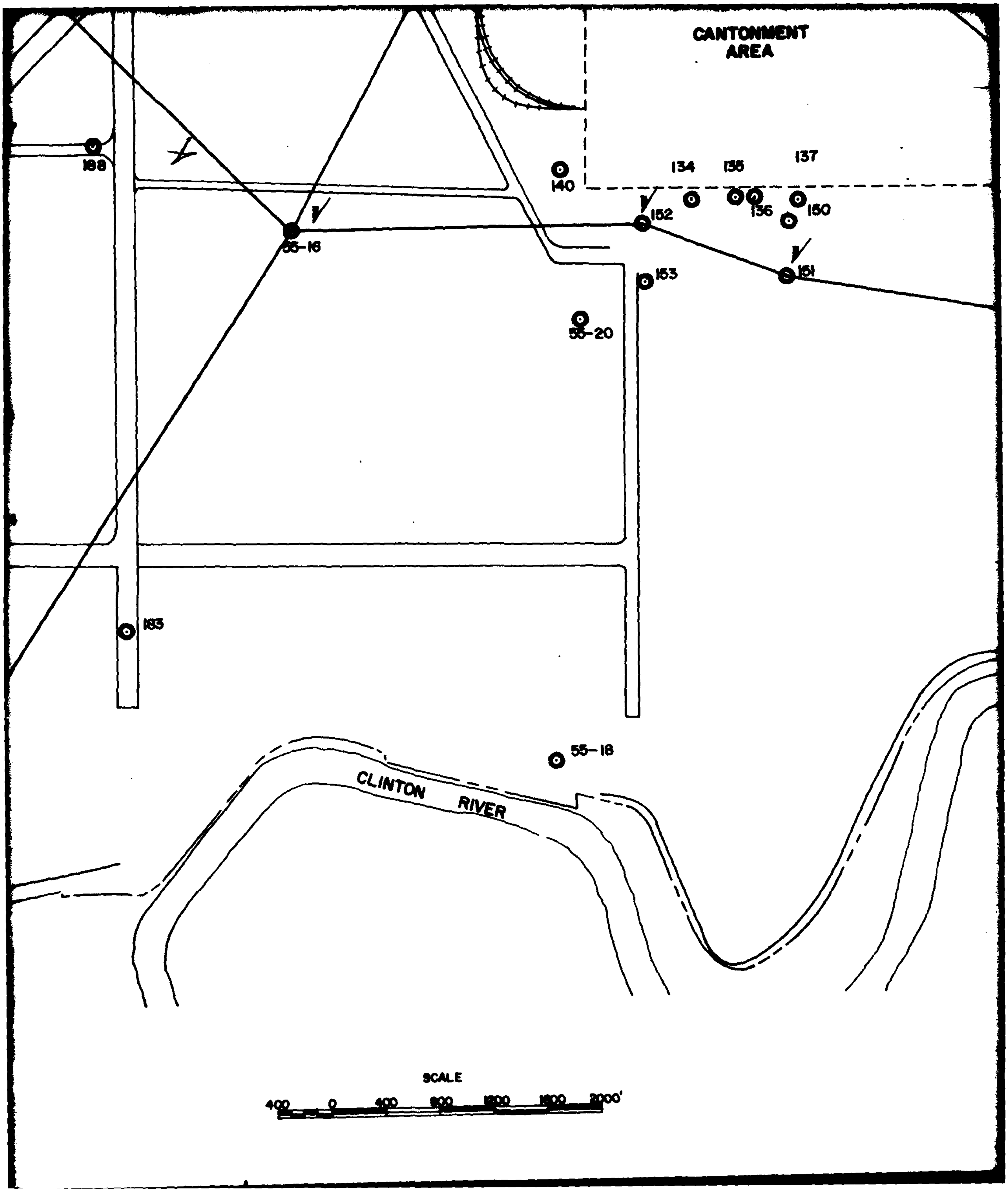
CANTONMENT AREA
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CLINTON RIVER
SCALE
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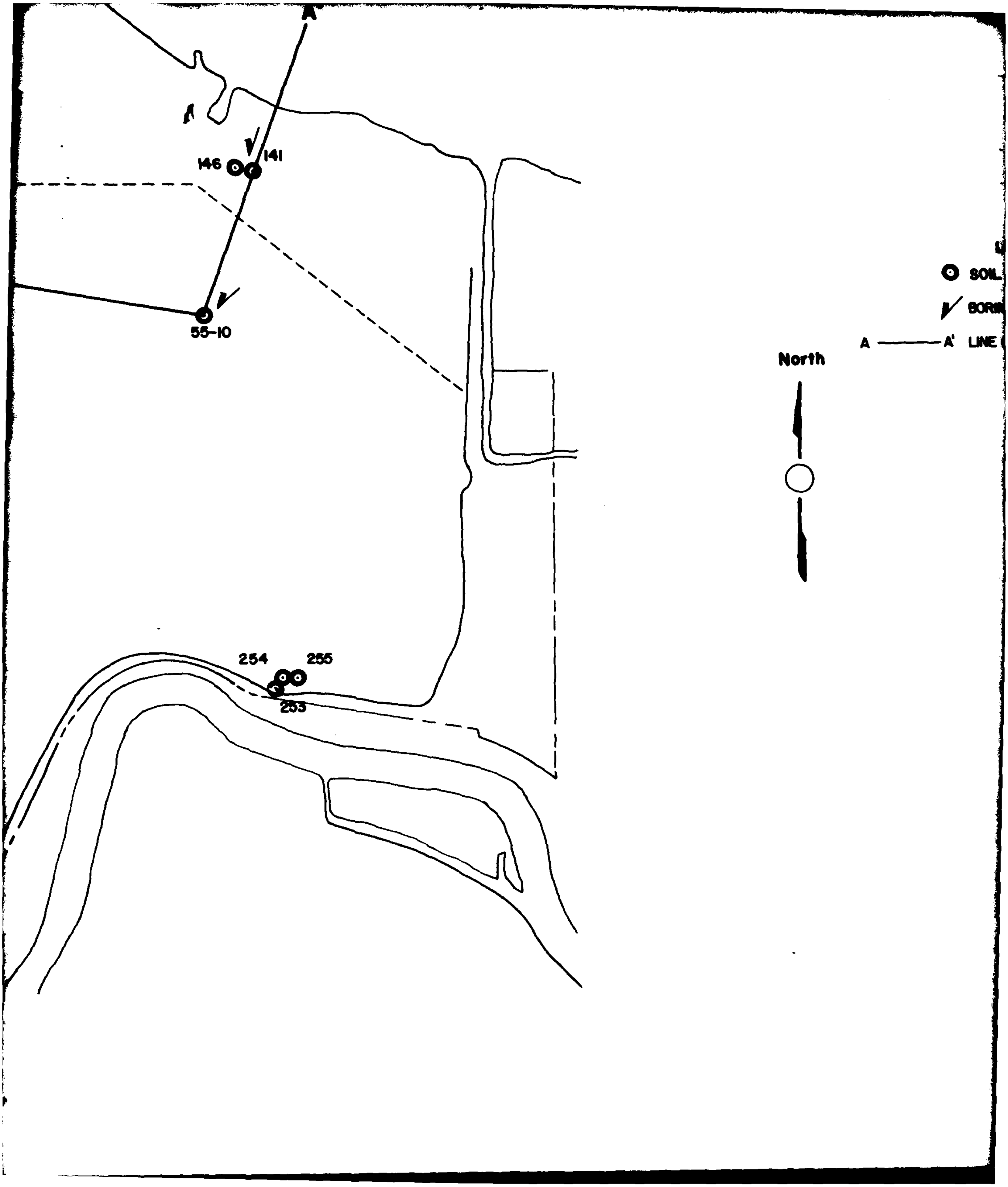
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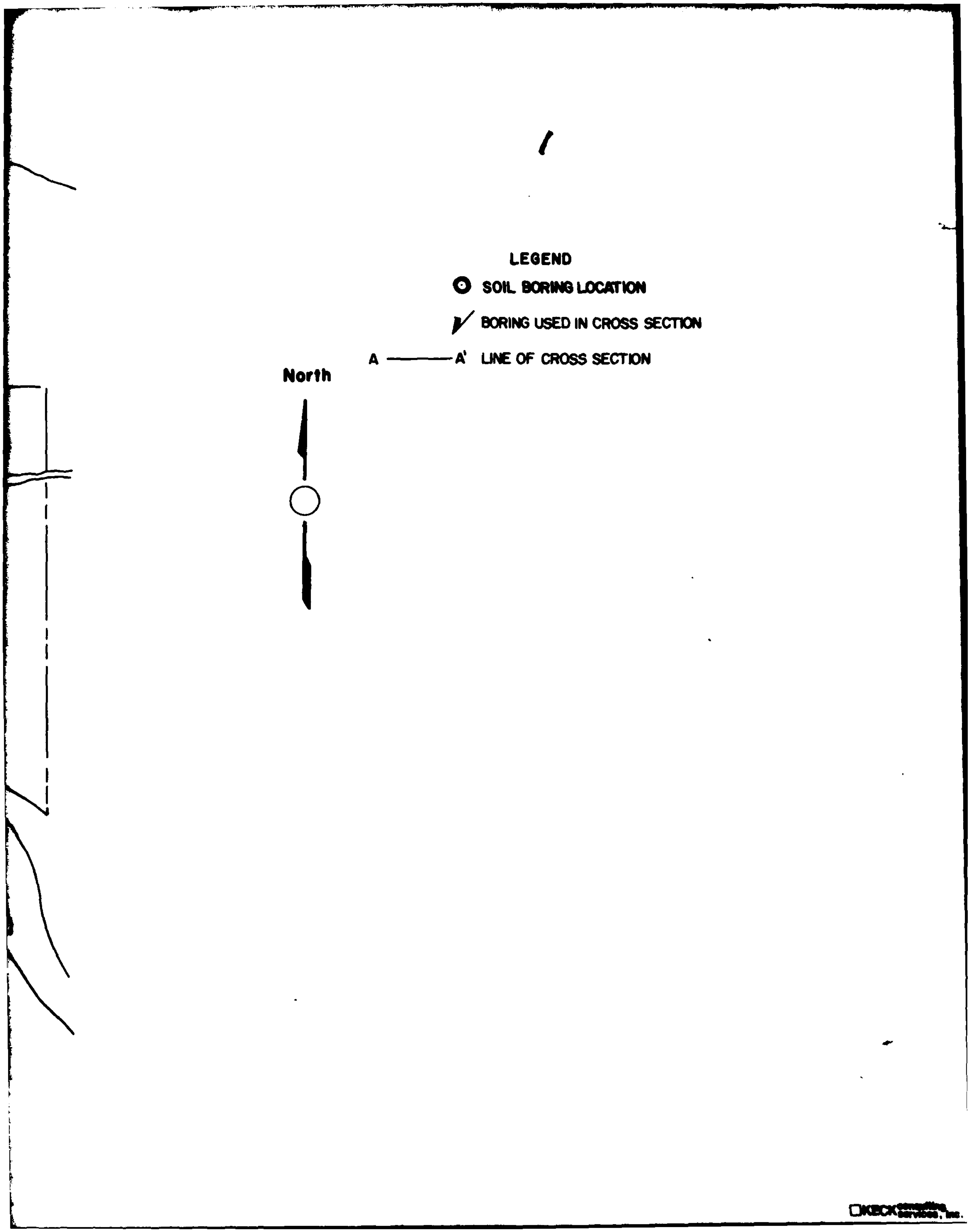
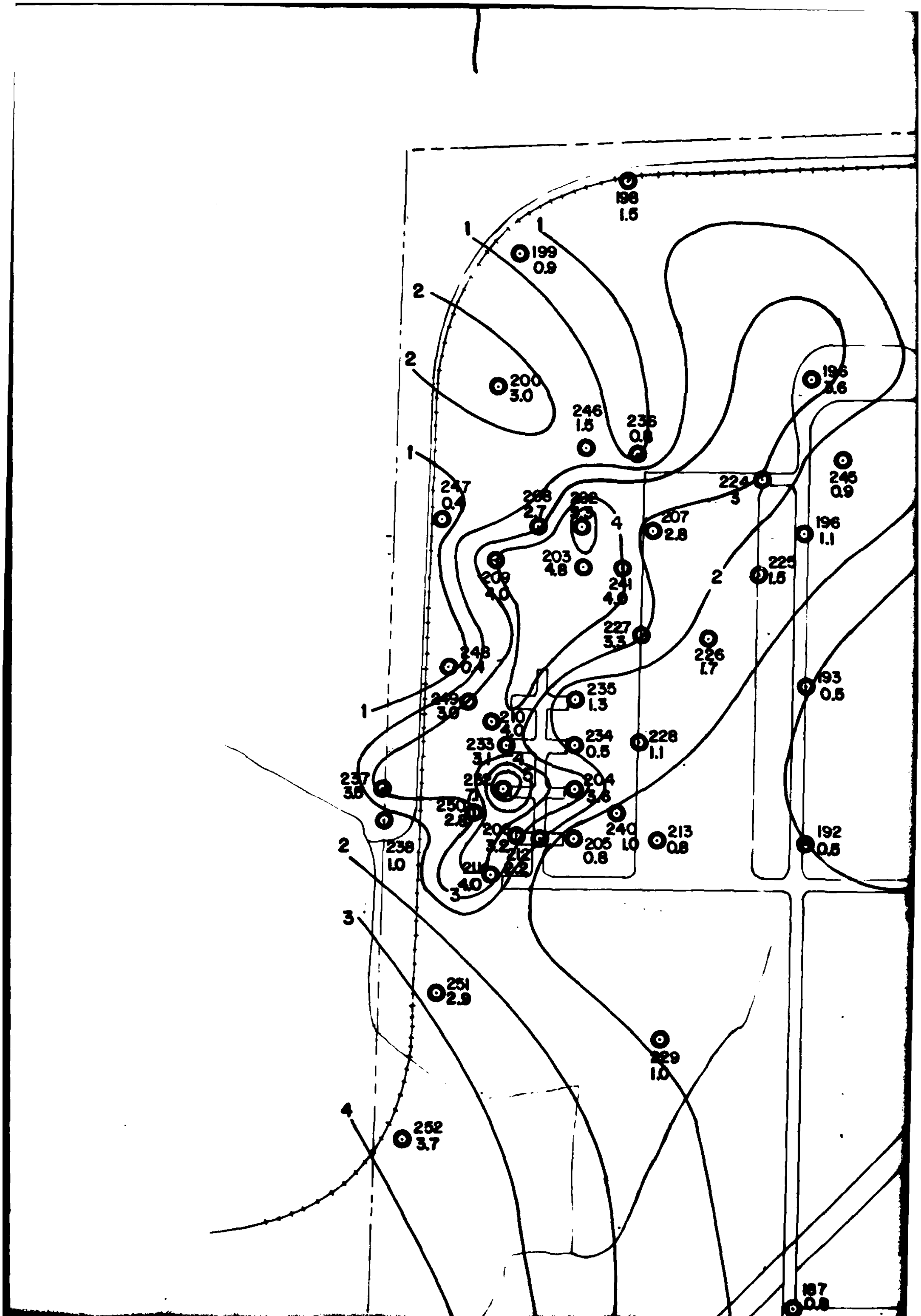

LEGEND
SOIL BORING LOCATION
BORING USED IN CROSS SECTION
A —— A' LINE OF CROSS SECTION
North
KECK consulting services, Inc.



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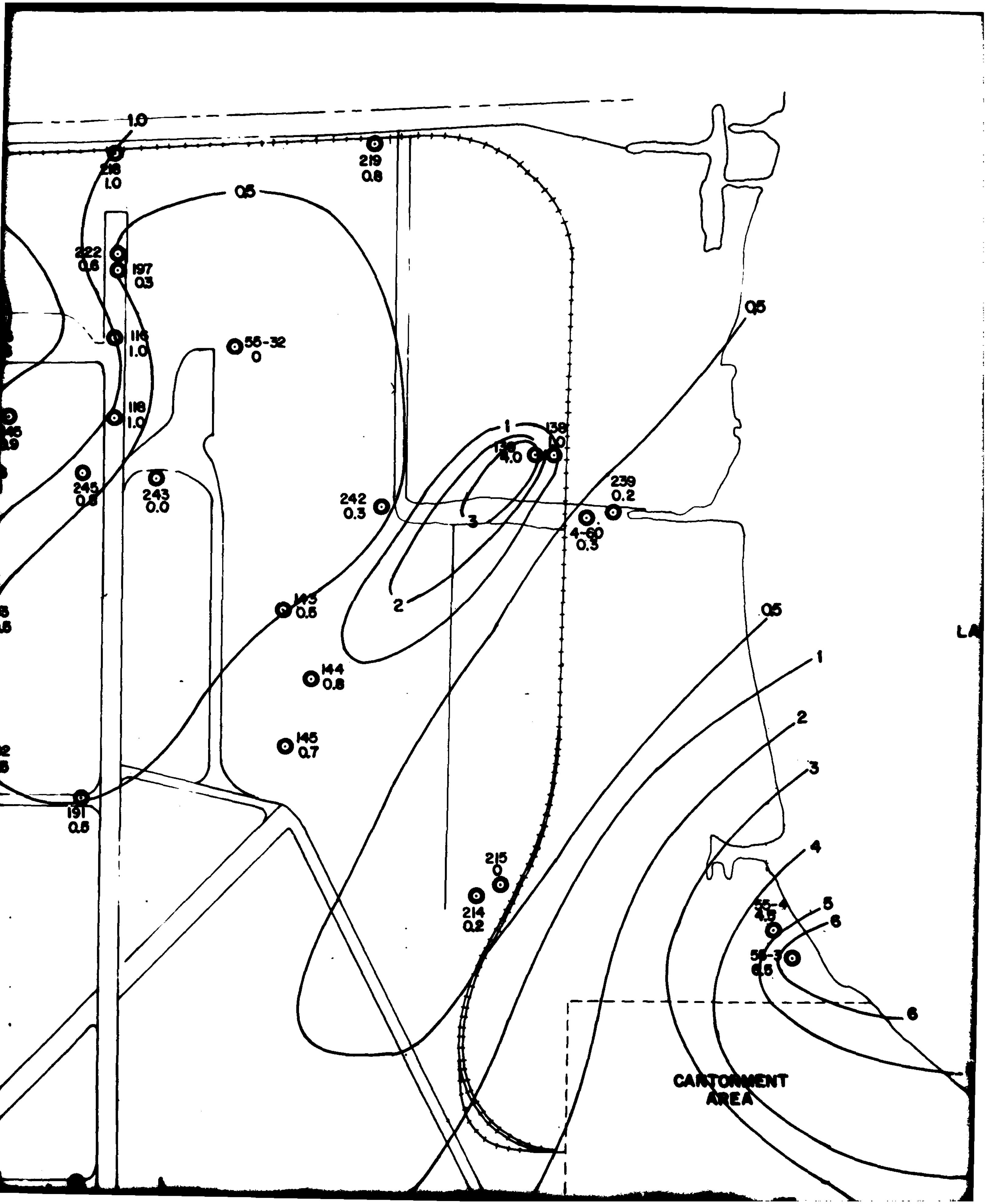

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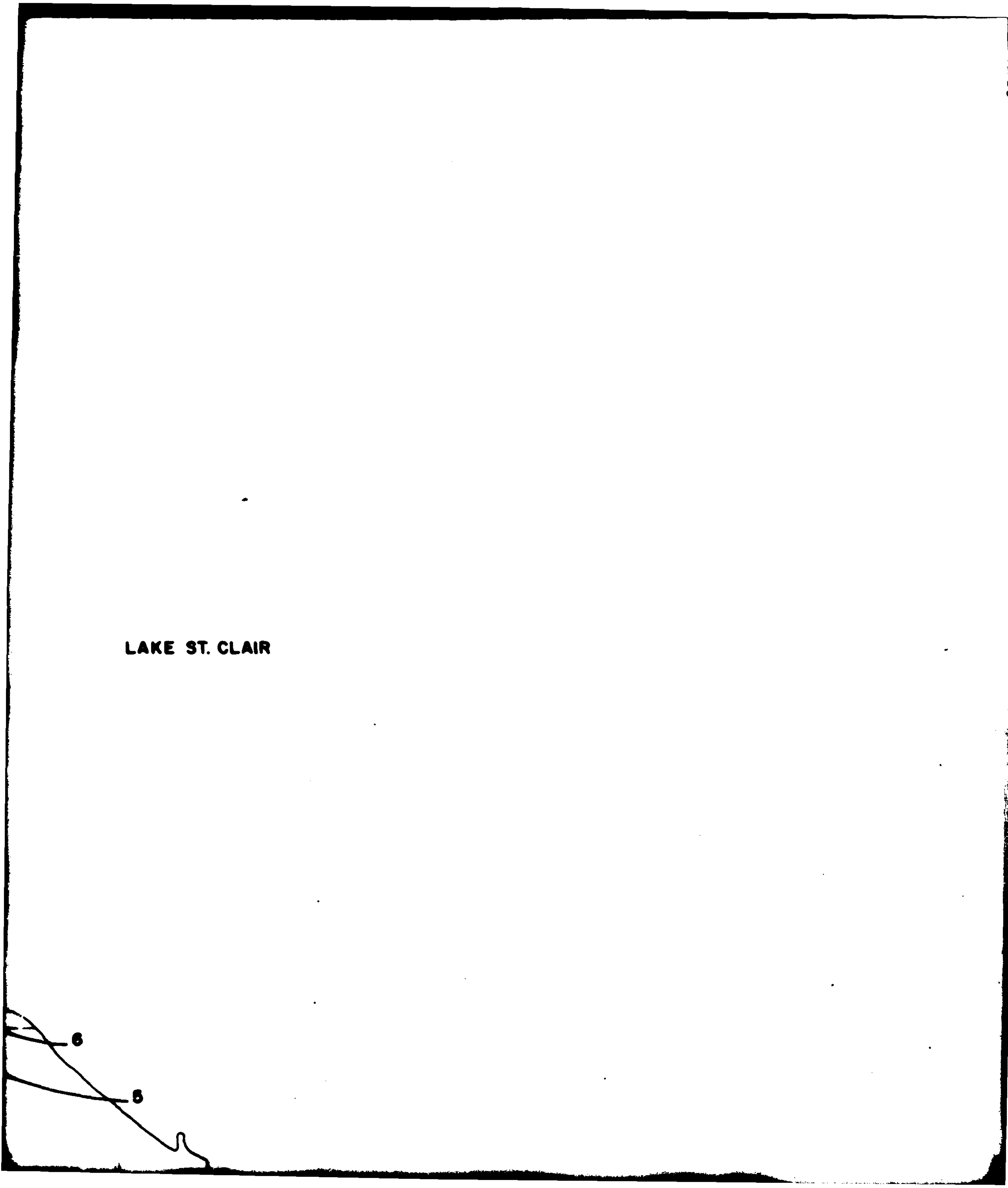

LAKE ST. CLAIR
6
5

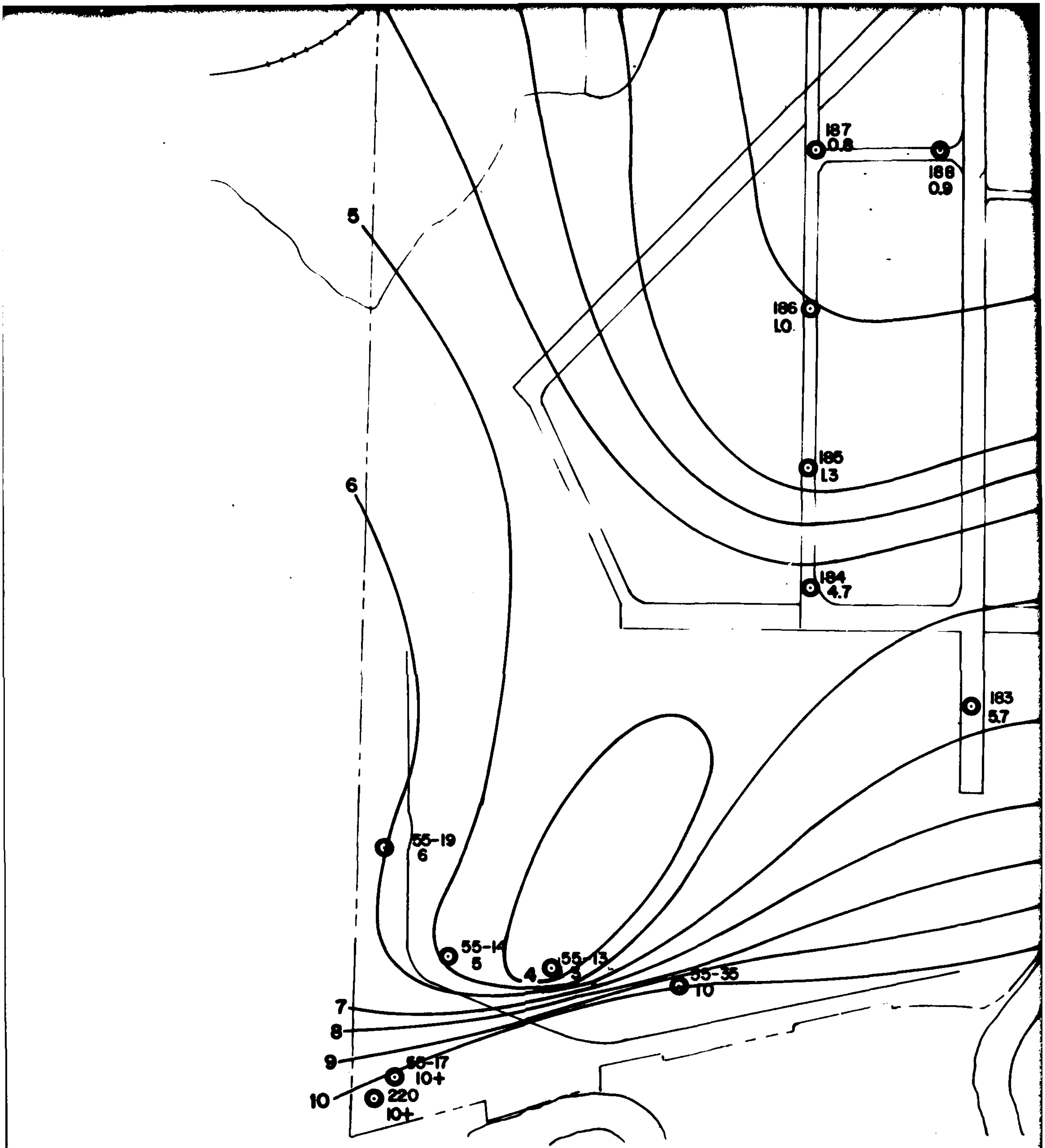
SELFRIDGE AIR FORCE BASE

MT. CLEMENS MICHIGAN

HARRISON TOWNSHIP, T.2N., R.13 & 14 E.

MACOMB COUNTY

ISOPACH MAP OF SAND WITHIN TEN FEET OF SURFACE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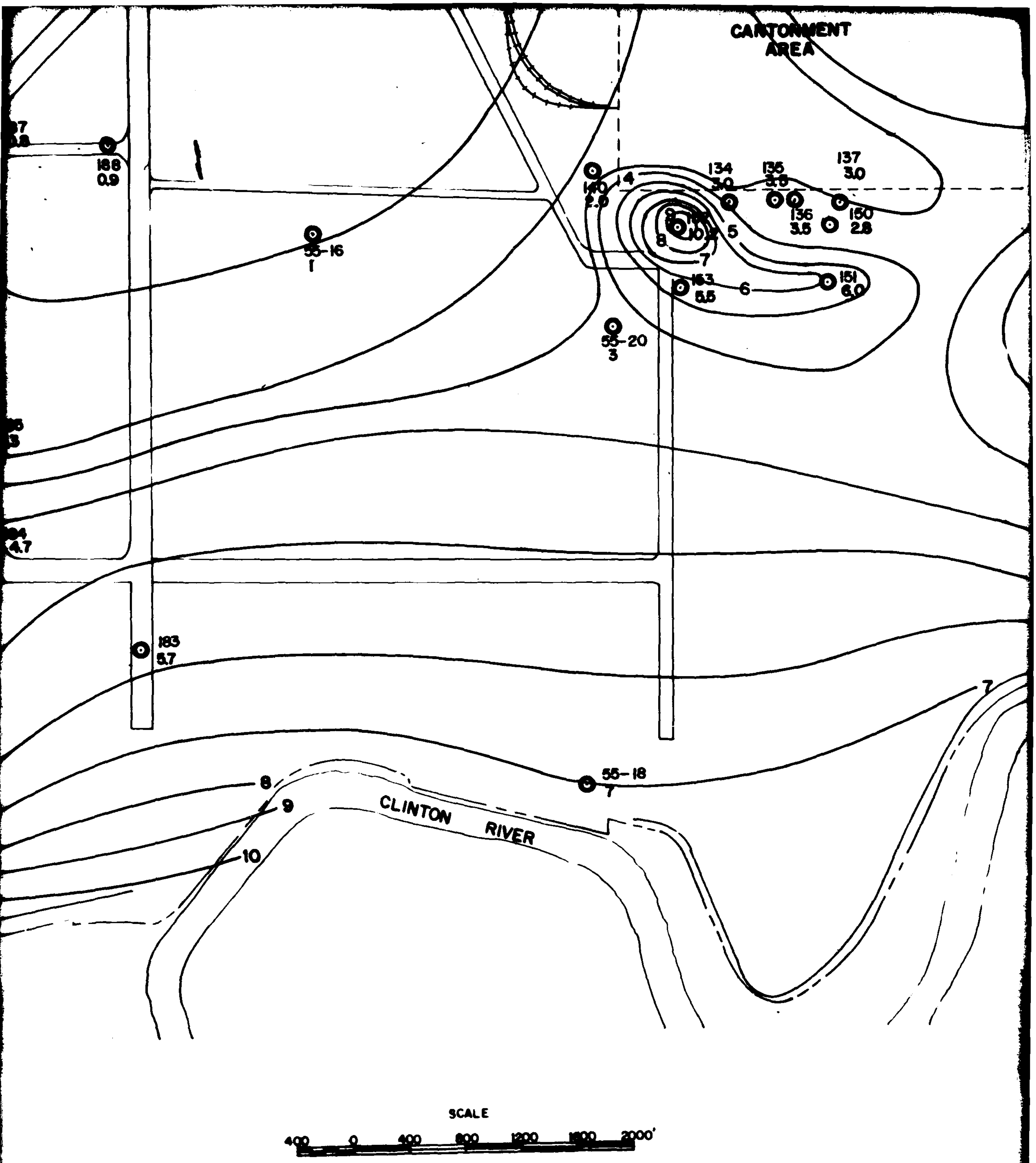

CANTONMENT AREA
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CLINTON RIVER
SCALE
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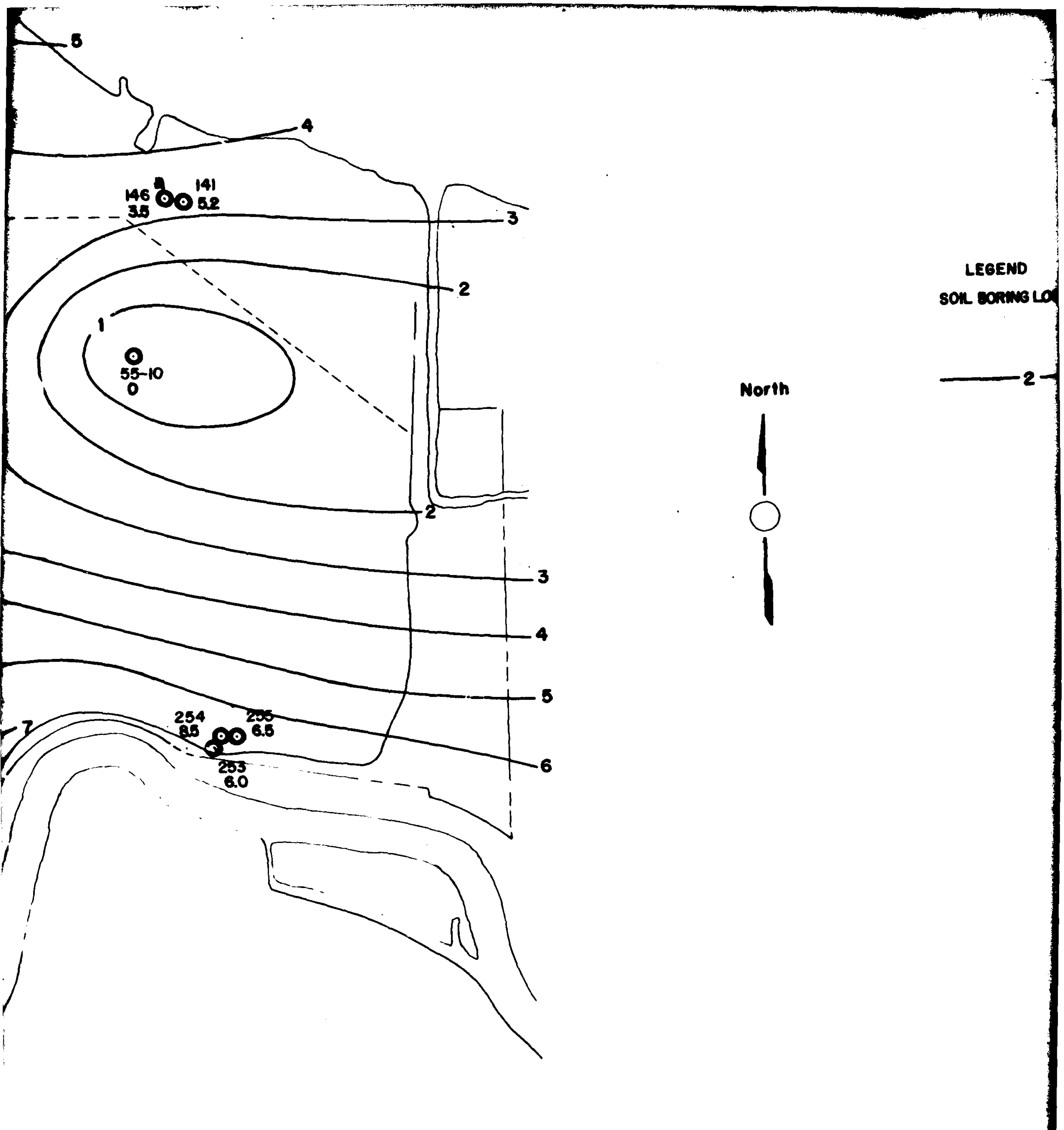

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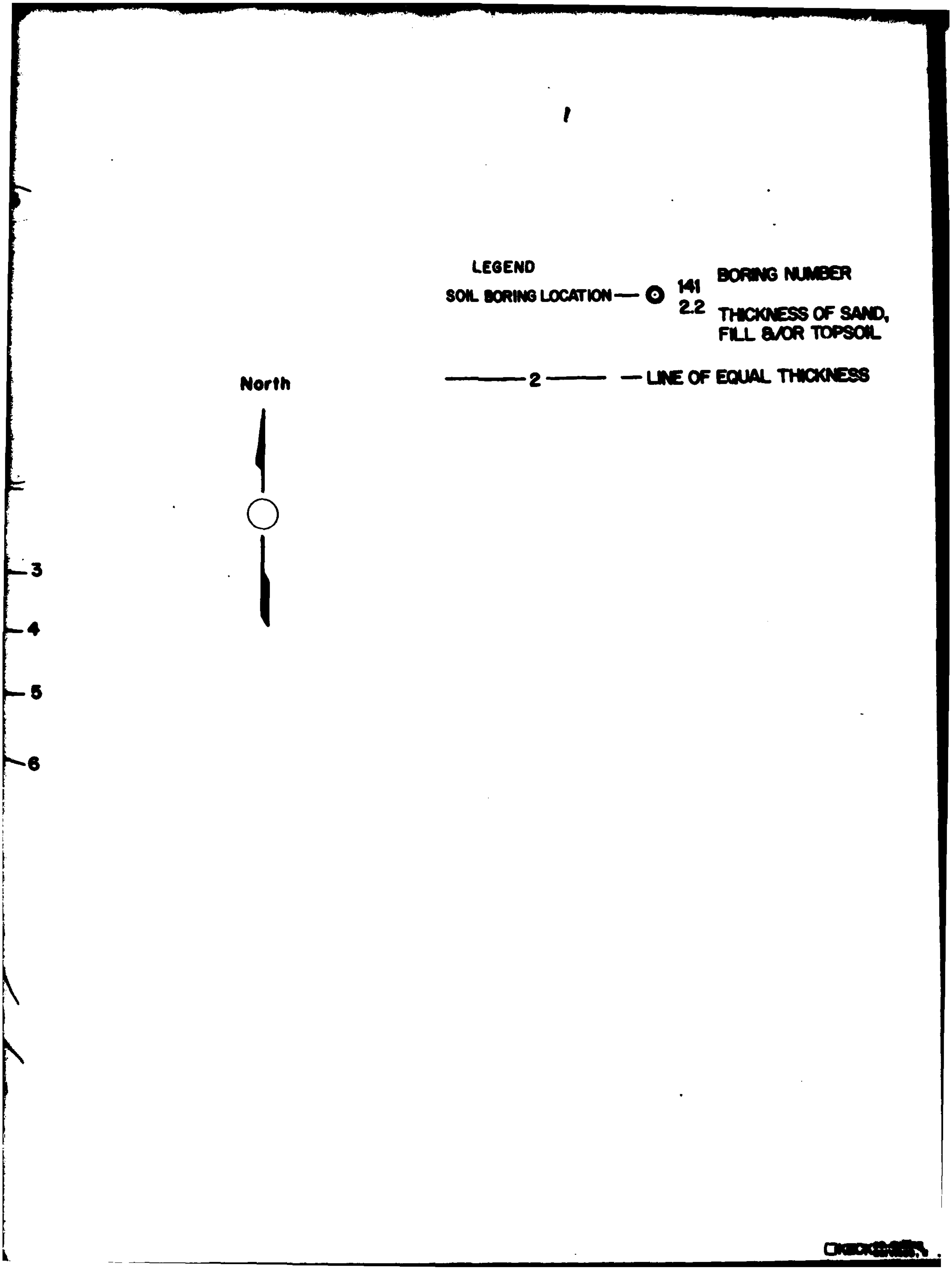
LEGEND
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141 BORING NUMBER
2.2 THICKNESS OF SAND, FILL &/OR TOPSOIL
2 LINE OF EQUAL THICKNESS
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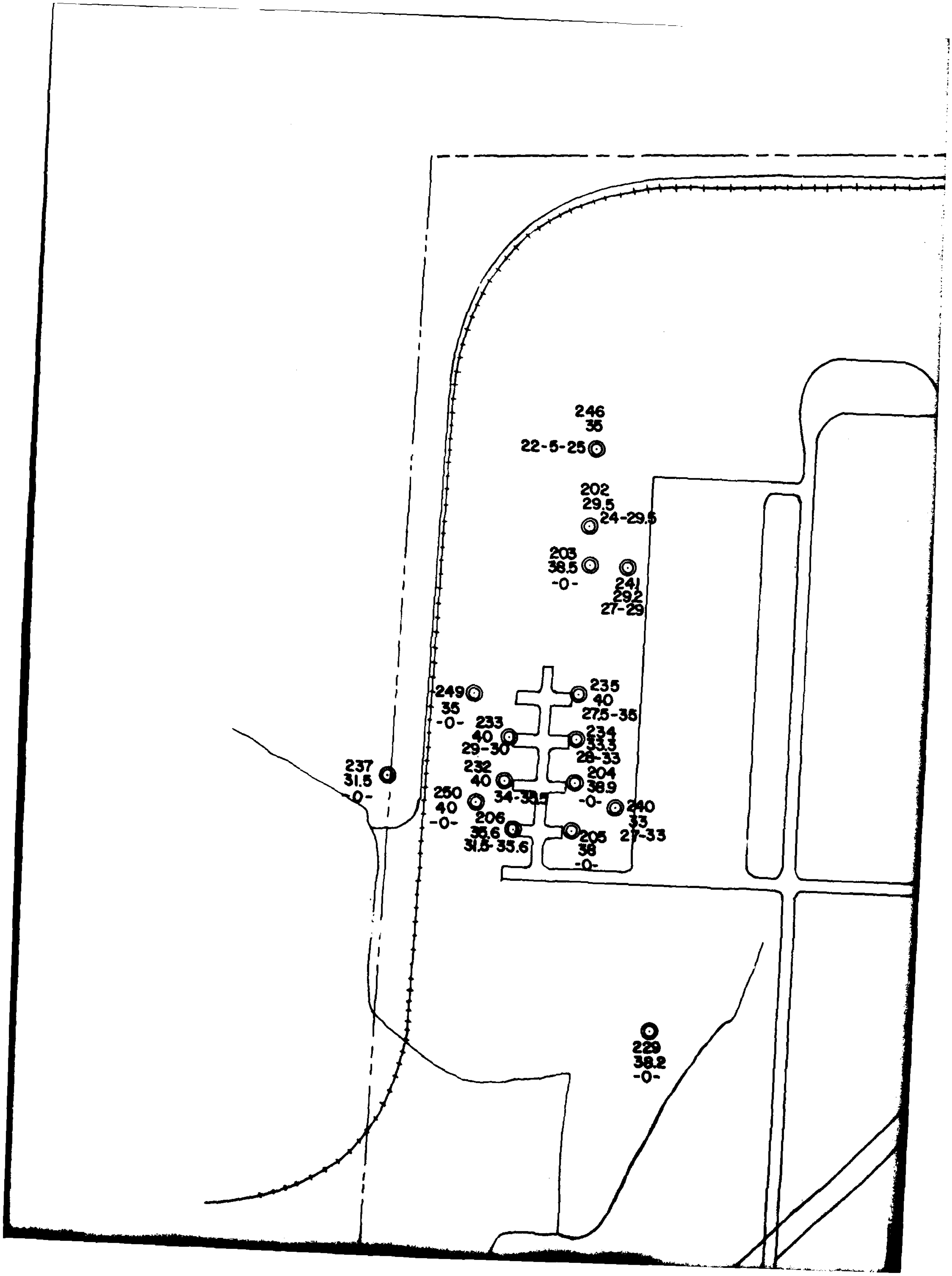
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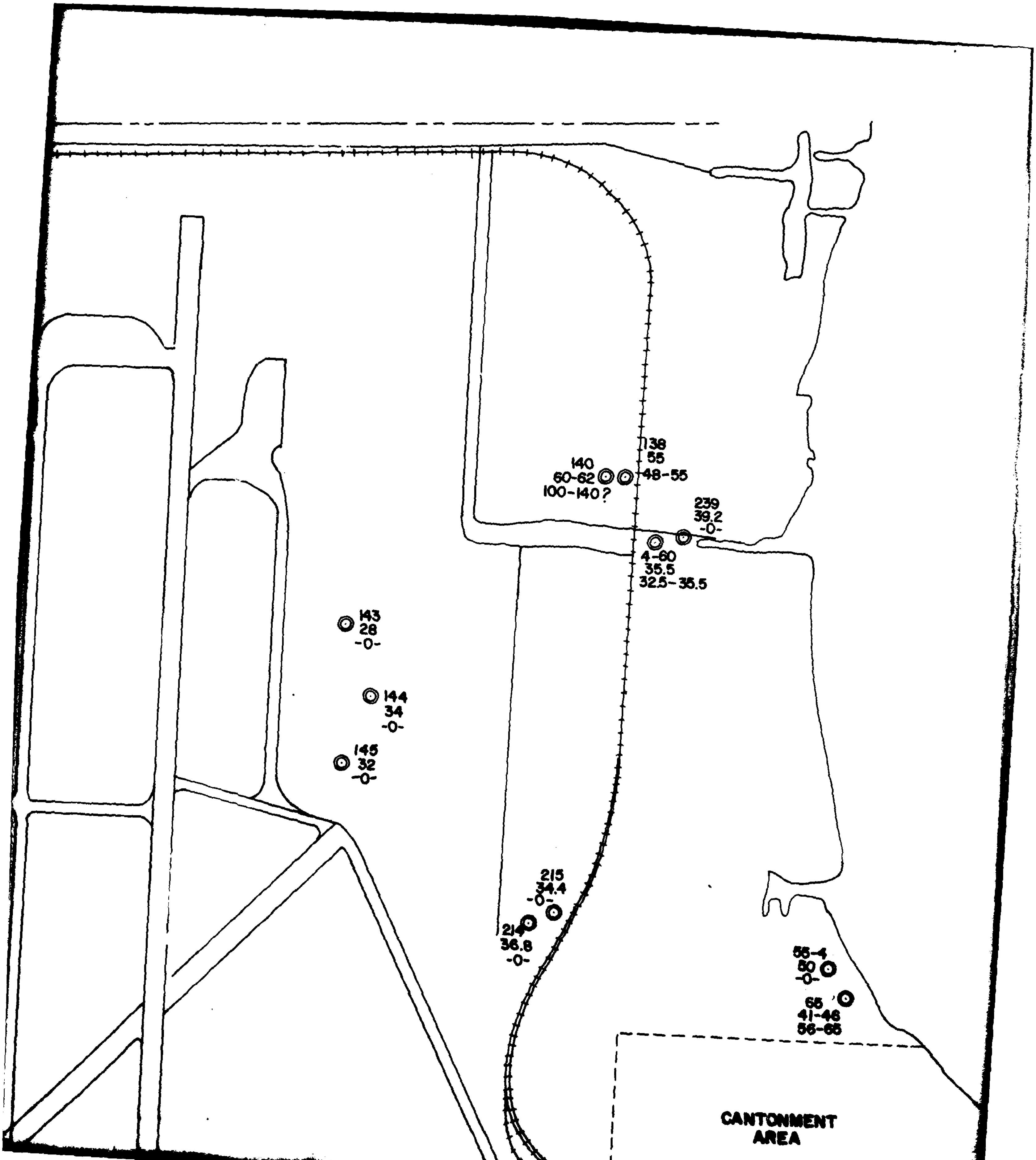
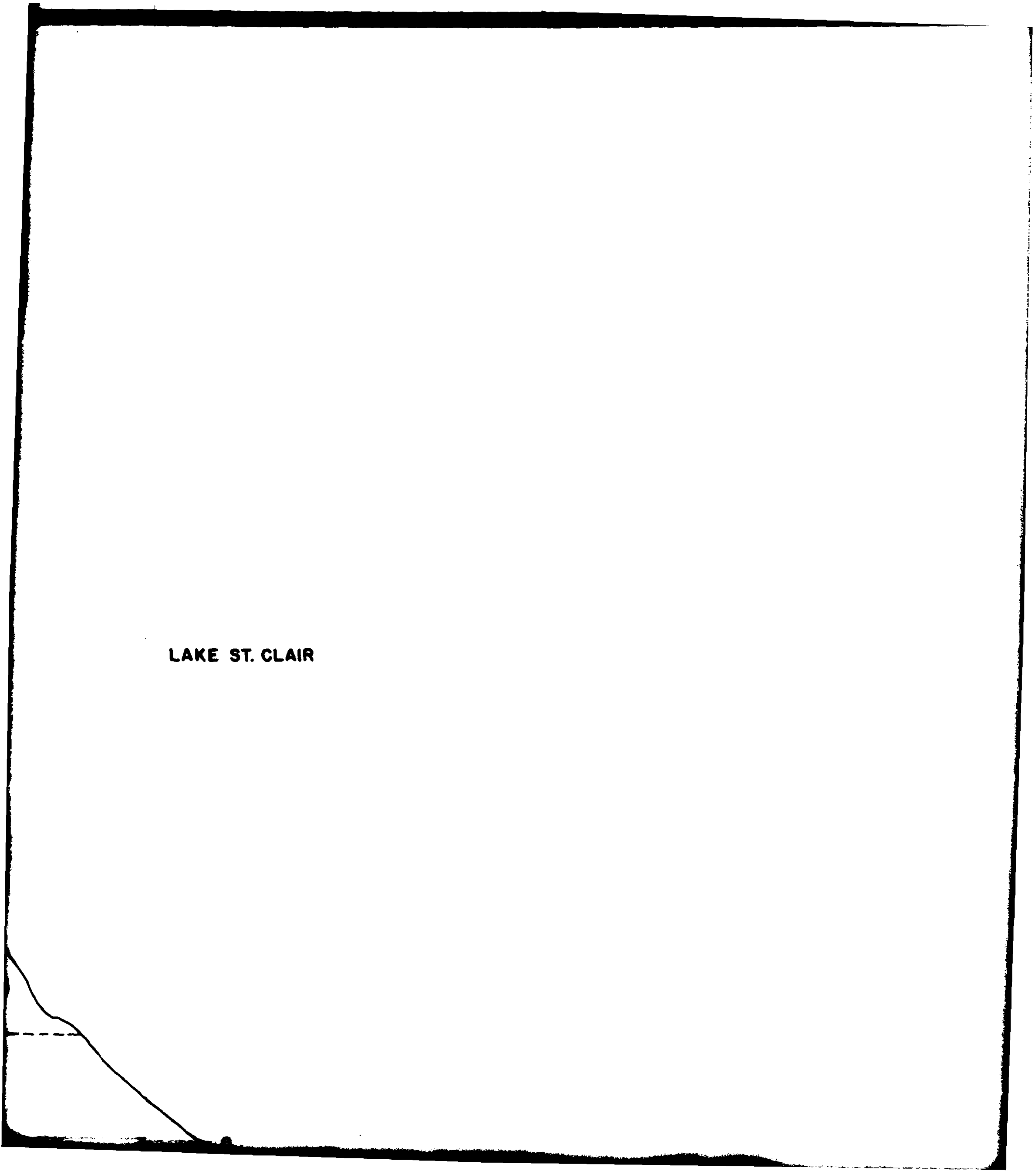
-0-
241
29.2
27-29
249
35
-0-
235
40
27.5-35
233
40
29-30
234
33.3
28-33
237
31.5
-0-
232
40
34-38.5
204
38.9
-0-
250
40
-0-
240
33
27-33
206
35.6
31.5-35.6
205
38
-0-
229
38.2
-0-



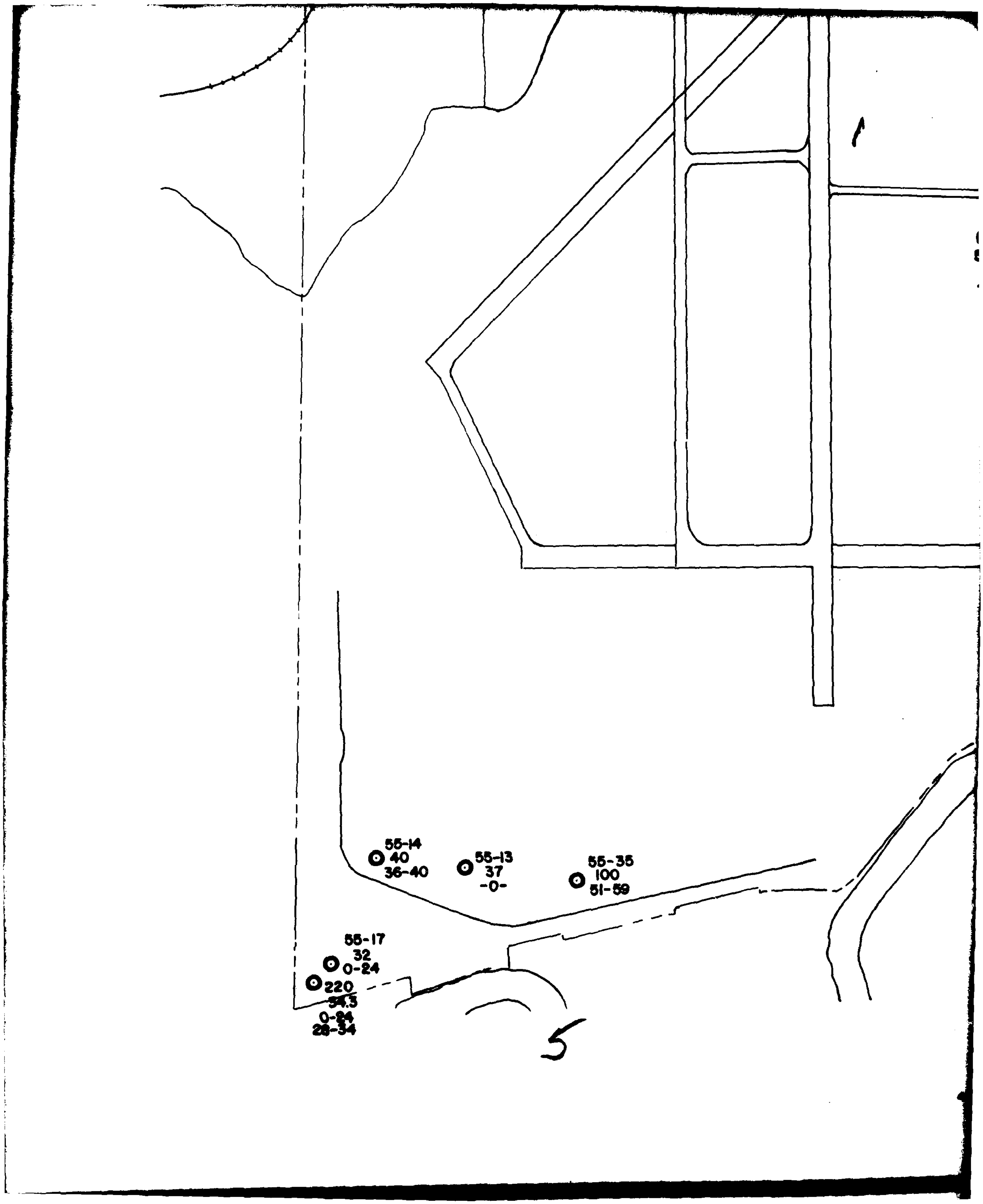
138
55
48-55
140
60-62
100-140?
239
39.2
-0-
4-60
35.5
32.5-35.5
143
28
-0-
144
34
-0-
145
32
-0-
215
34.4
-0-
214
36.8
-0-
55-4
50
-0-
65
41-46
56-65
CANTONMENT
AREA


LAKE ST. CLAIR

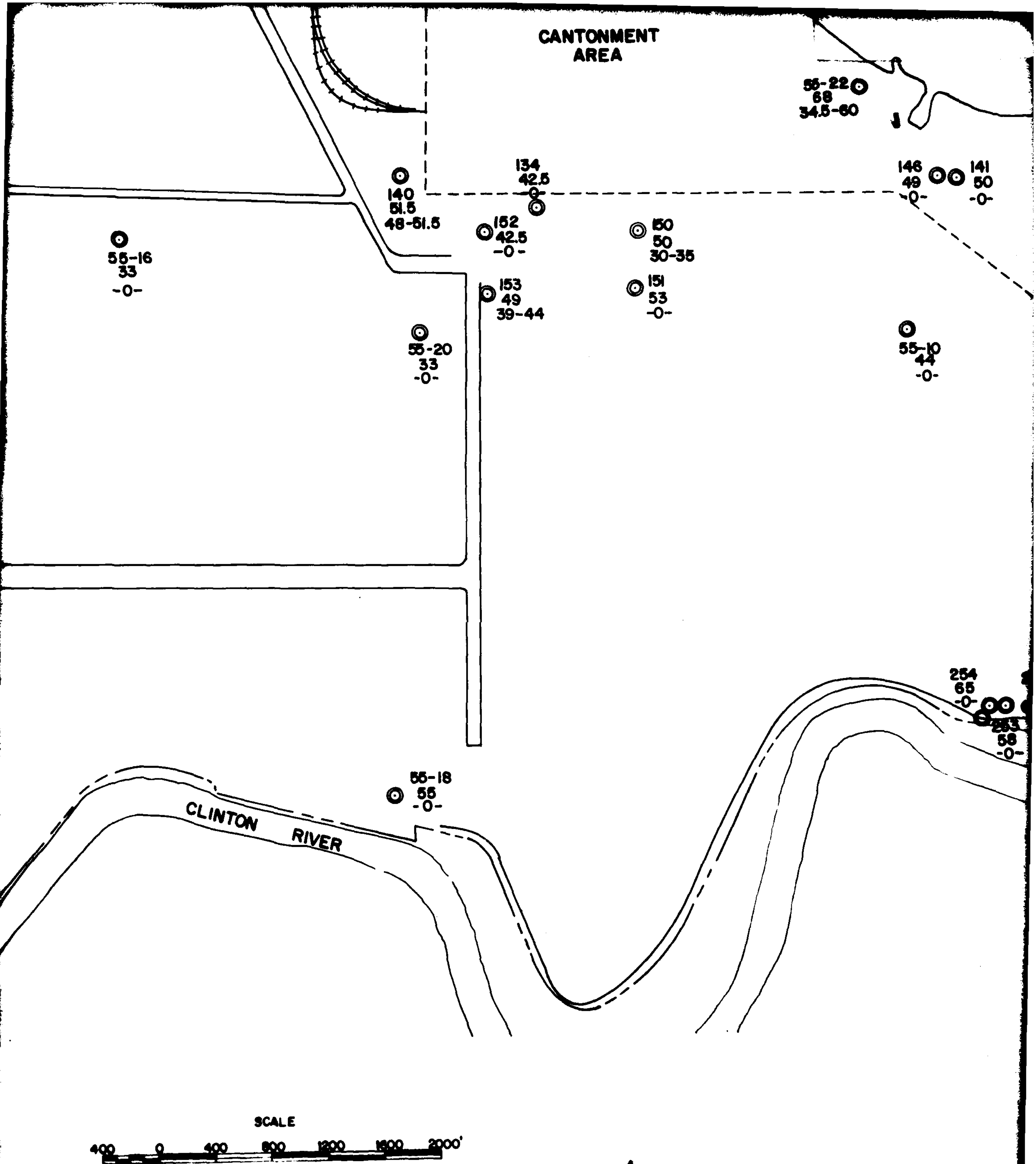
SELFRIDGE AIR FORCE BASE

MT. CLEMENS MICHIGAN

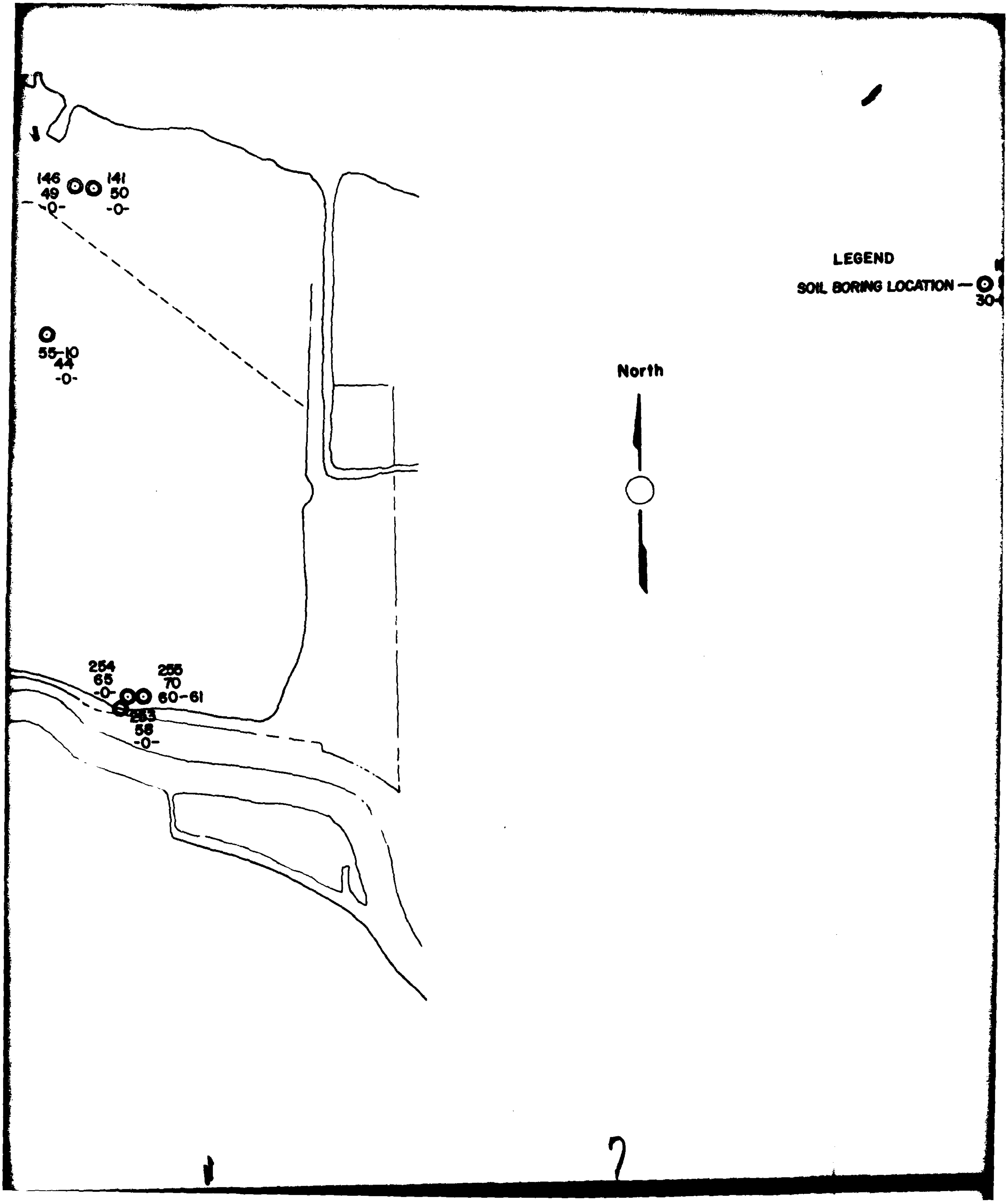
MAP OF DEEPER SAND INTERVALS



55-14
40
36-40
55-13
37
-0-
55-35
100
51-59
55-17
32
0-24
220
34.3
0-24
28-34
5

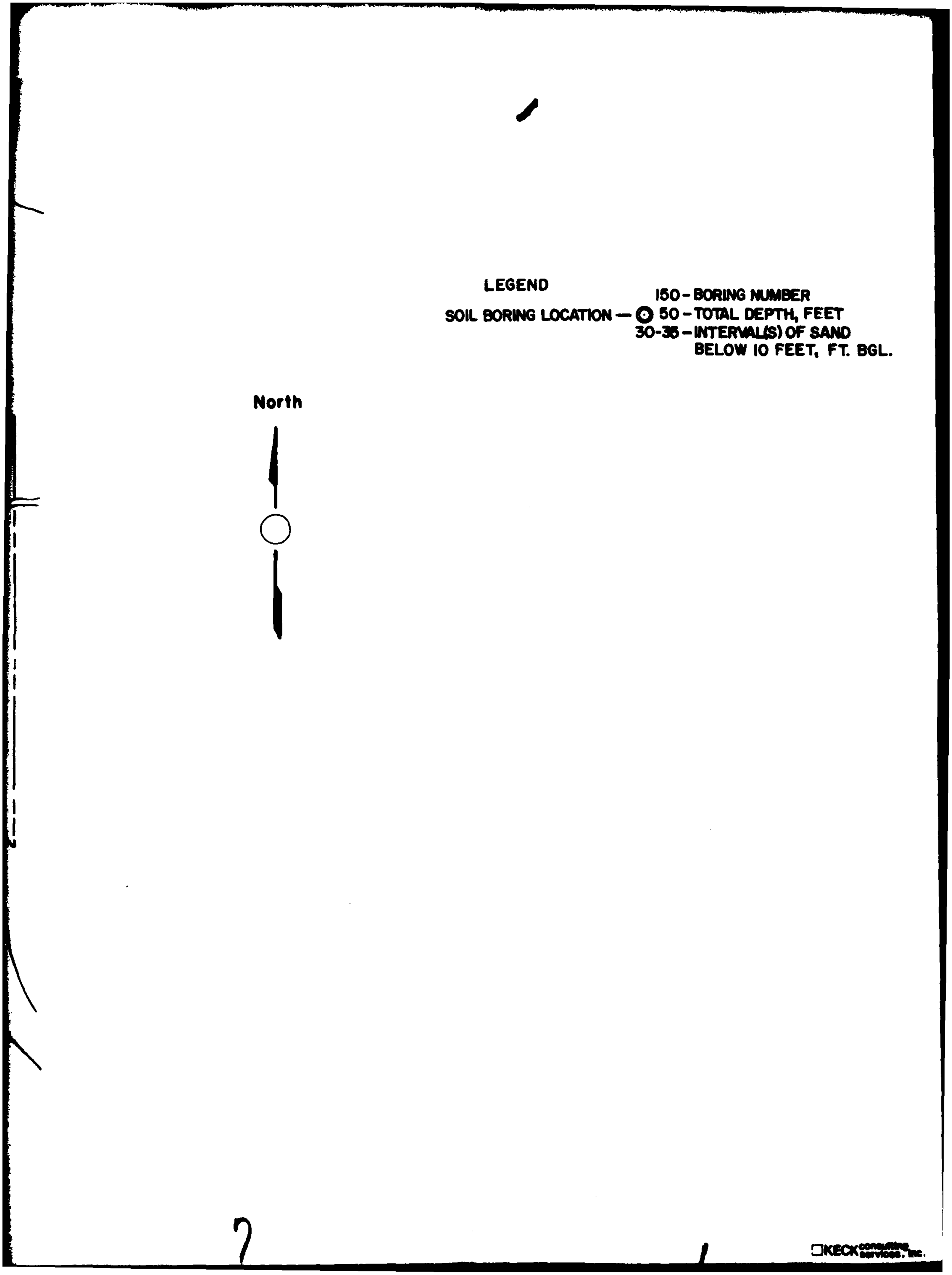

CANTONMENT
AREA
55-22
68
34.5-60
134
42.5
-0-
140
51.5
48-51.5
146
49
-0-
141
50
-0-
152
42.5
-0-
150
50
30-35
55-16
33
-0-
153
49
39-44
151
53
-0-
55-20
33
-0-
55-10
44
-0-
254
65
-0-
253
58
-0-
55-18
55
-0-
CLINTON RIVER
SCALE
400 0 400 800 1200 1600 2000'

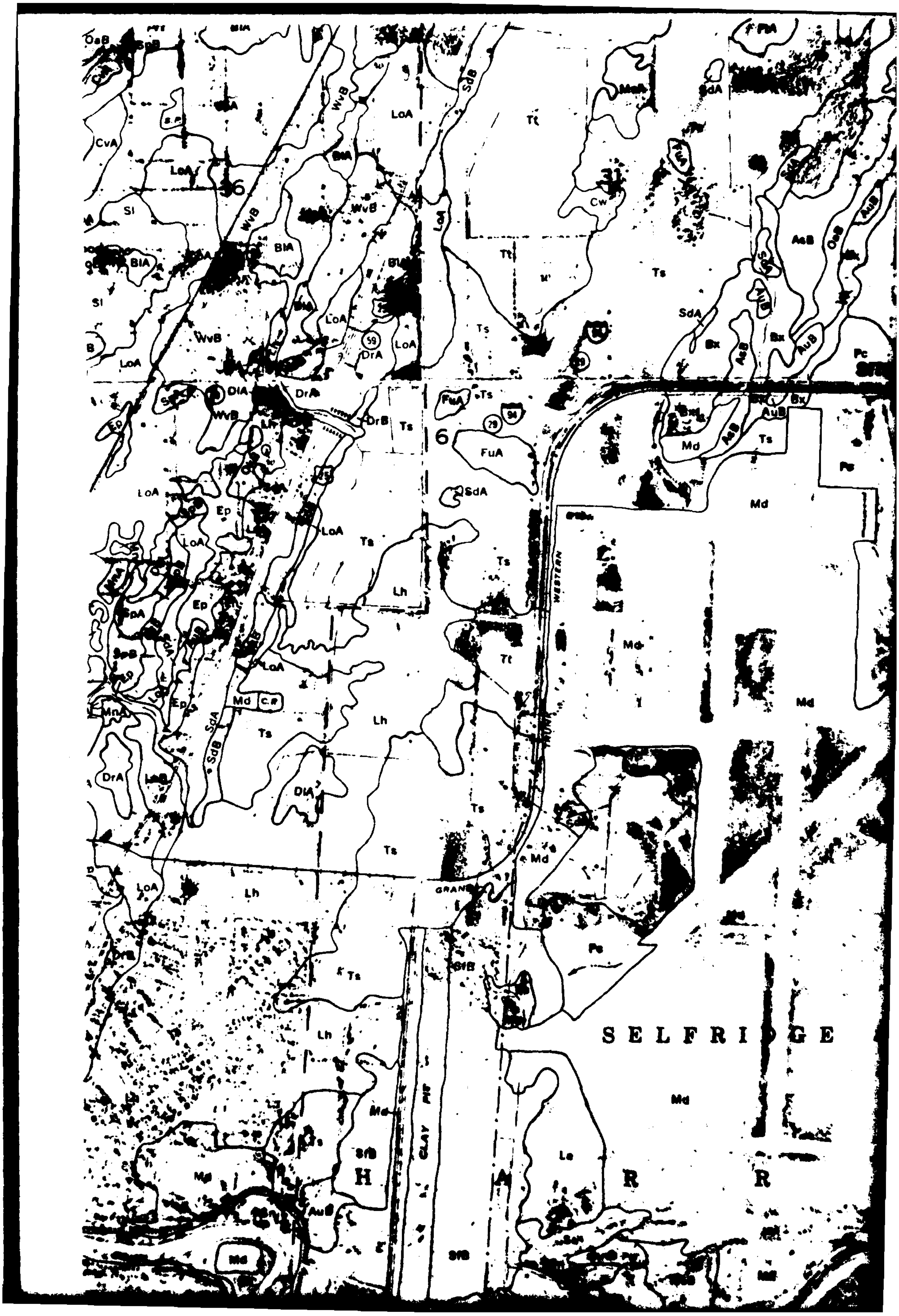
6



146
49
-0-
141
50
-0-
55-10
44
-0-
254
65
-0-
255
70
60-61
253
58
-0-
North
LEGEND
SOIL BORING LOCATION
30-

7


LEGEND
SOIL BORING LOCATION — 150 - BORING NUMBER
50 - TOTAL DEPTH, FEET
30-35 - INTERVAL(S) OF SAND BELOW 10 FEET, FT. BGL.
North
KECK consulting services, inc.



SELFRIDGE
H
R
R
LoA
Tt
Ts
SdA
SdB
WvB
BlA
CvA
Cw
AsB
Bx
Pc
FuA
DrA
DrB
Ep
Lh
Md
Pe
Le
SfB
AuB
GRAND
CLAY
WESTERN
36
31
6

SELFRIDGE AIR NATIONAL GUARD B

SOIL CLASSIFICATION MAP

Scale 1:20000

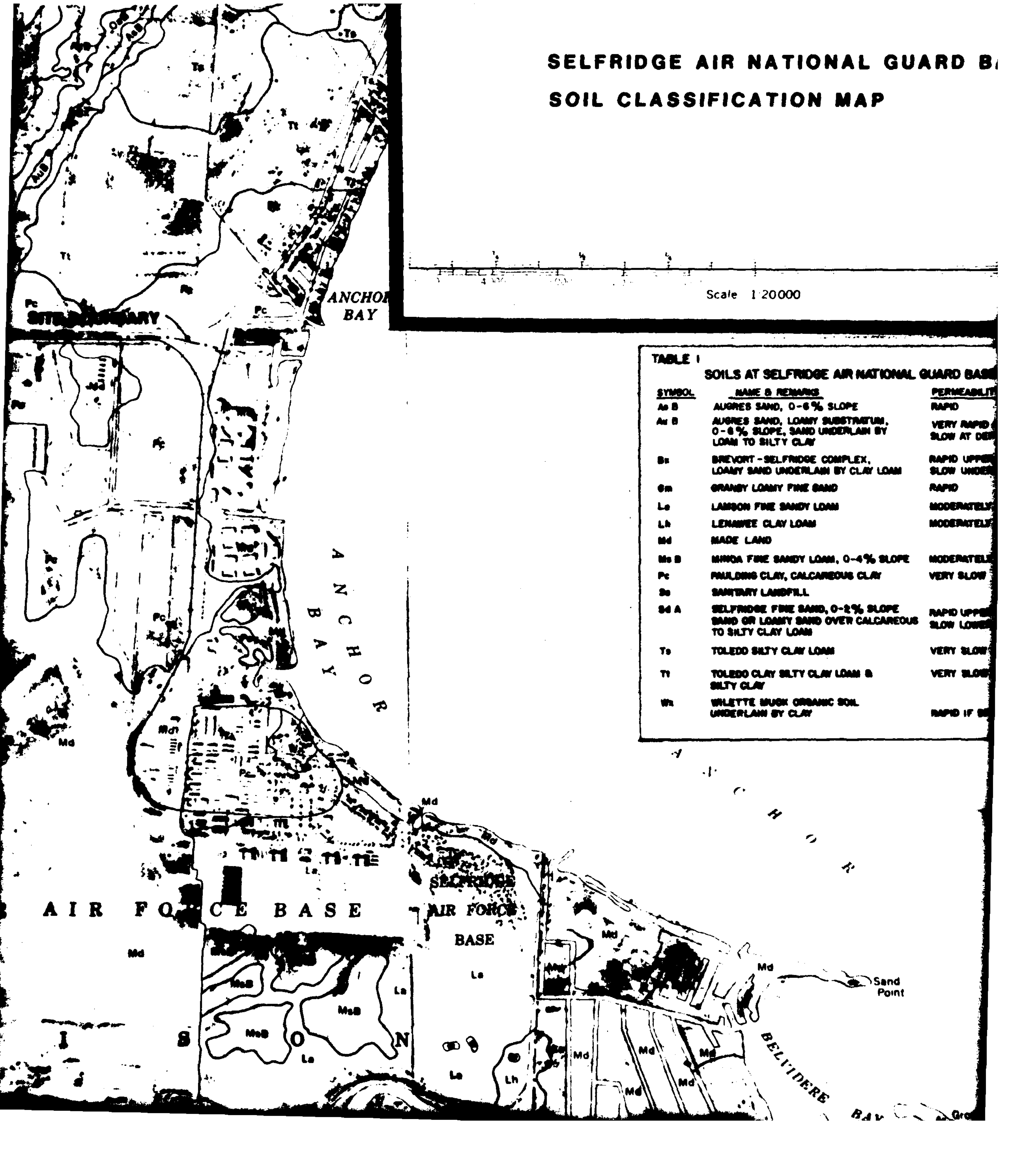


TABLE I

SOILS AT SELFRIDGE AIR NATIONAL GUARD BAS

SYMBOL	NAME & REMARKS	PERMEABILIT
As B	AUGRES SAND, 0-6% SLOPE	RAPID
Au B	AUGRES SAND, LOAMY SUBSTRATUM, 0-6% SLOPE, SAND UNDERLAIN BY LOAM TO SILTY CLAY	VERY RAPID SLOW AT DE
Bs	BREVORT-SELFRIDGE COMPLEX, LOAMY SAND UNDERLAIN BY CLAY LOAM	RAPID UPPE SLOW UNDE
Gm	GRANBY LOAMY FINE SAND	RAPID
La	LAMSON FINE SANDY LOAM	MODERATELY
Lh	LENAWEE CLAY LOAM	MODERATELY
Md	MADE LAND	
Ms B	MINOA FINE SANDY LOAM, 0-4% SLOPE	MODERATEL
Pc	PAULDING CLAY, CALCAREOUS CLAY	VERY SLOW
Sa	SANITARY LANDFILL	
Sd A	SELFRIDGE FINE SAND, 0-2% SLOPE SAND OR LOAMY SAND OVER CALCAREOUS TO SILTY CLAY LOAM	RAPID UPPE SLOW LOWE
Ts	TOLEDO SILTY CLAY LOAM	VERY SLOW
Tt	TOLEDO CLAY SILTY CLAY LOAM & SILTY CLAY	VERY SLOW
Wt	WILETTE MUCK ORGANIC SOIL UNDERLAIN BY CLAY	RAPID IF

SELFRIDGE AIR NATIONAL GUARD BASE
SOIL CLASSIFICATION MAP

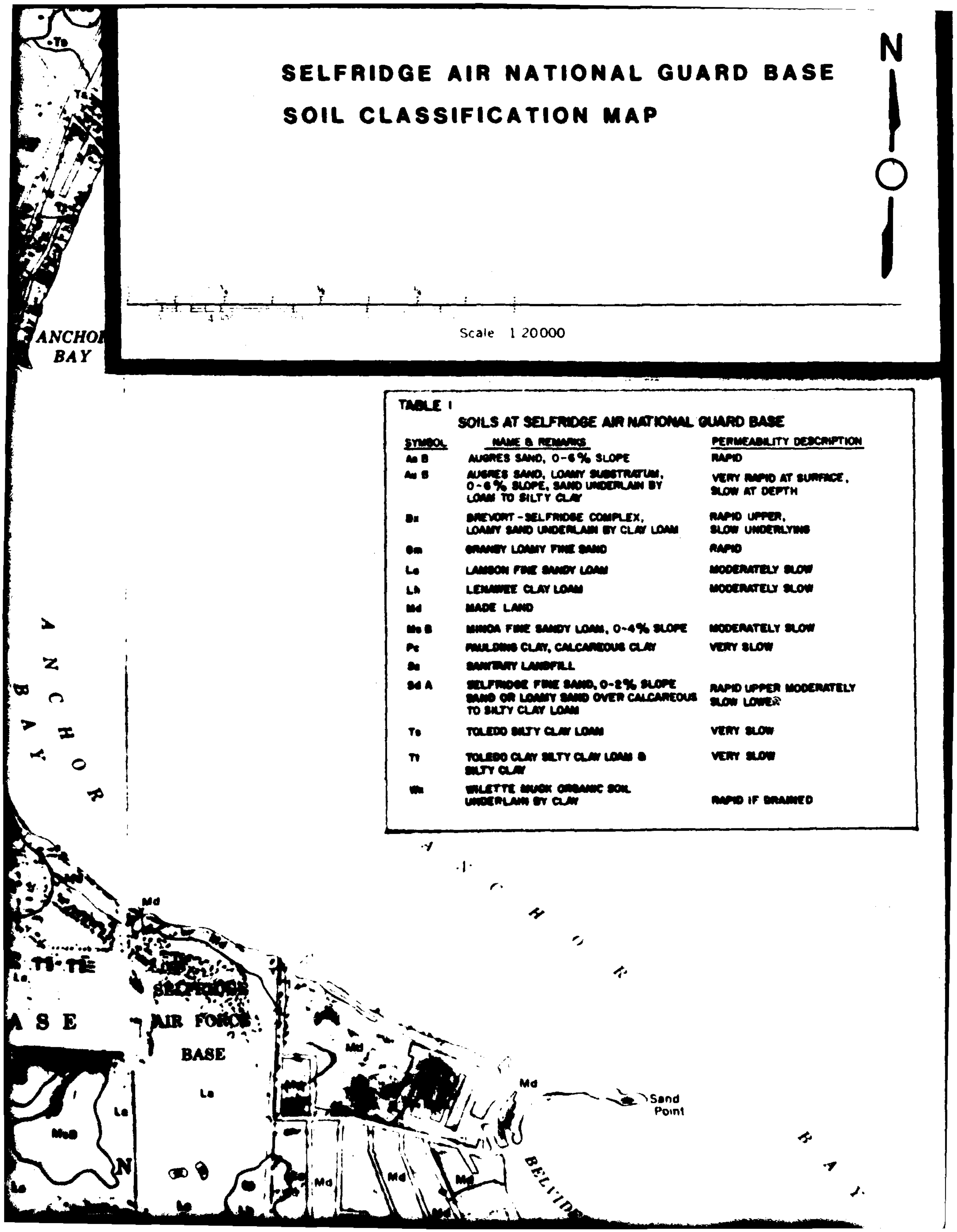
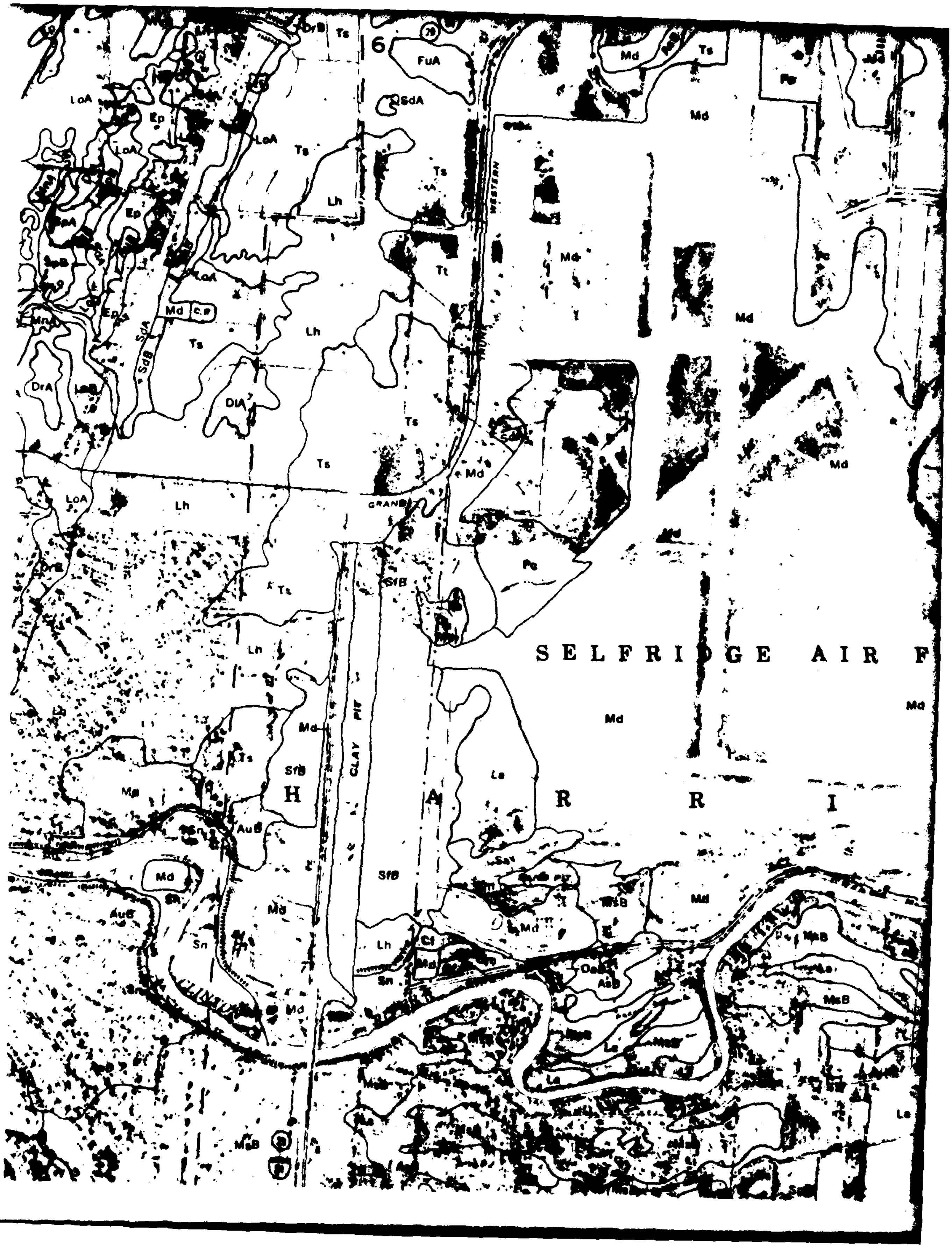


TABLE I

SOILS AT SELFRIDGE AIR NATIONAL GUARD BASE

SYMBOL	NAME & REMARKS	PERMEABILITY DESCRIPTION
As B	AUGRES SAND, 0-6% SLOPE	RAPID
Au B	AUGRES SAND, LOAMY SUBSTRATUM, 0-6% SLOPE, SAND UNDERLAIN BY LOAM TO SILTY CLAY	VERY RAPID AT SURFACE, SLOW AT DEPTH
Bx	BREVORT - SELFRIDGE COMPLEX, LOAMY SAND UNDERLAIN BY CLAY LOAM	RAPID UPPER, SLOW UNDERLYING
Gm	GRANBY LOAMY FINE SAND	RAPID
Le	LAMSON FINE SANDY LOAM	MODERATELY SLOW
Lh	LENAWEE CLAY LOAM	MODERATELY SLOW
Md	MADE LAND	
Ms B	MINOA FINE SANDY LOAM, 0-4% SLOPE	MODERATELY SLOW
Pc	PAULDING CLAY, CALCAREOUS CLAY	VERY SLOW
Sa	SANITARY LANDFILL	
Sd A	SELFRIDGE FINE SAND, 0-2% SLOPE SAND OR LOAMY SAND OVER CALCAREOUS TO SILTY CLAY LOAM	RAPID UPPER MODERATELY SLOW LOWER
To	TOLEDO SILTY CLAY LOAM	VERY SLOW
Tt	TOLEDO CLAY SILTY CLAY LOAM & SILTY CLAY	VERY SLOW
Wn	WILLETTE MUCK ORGANIC SOIL UNDERLAIN BY CLAY	RAPID IF DRAINED


SELFRIDGE AIR F
H A R R I
CLAY PIT
GRAND
WESTERN
CLINTON

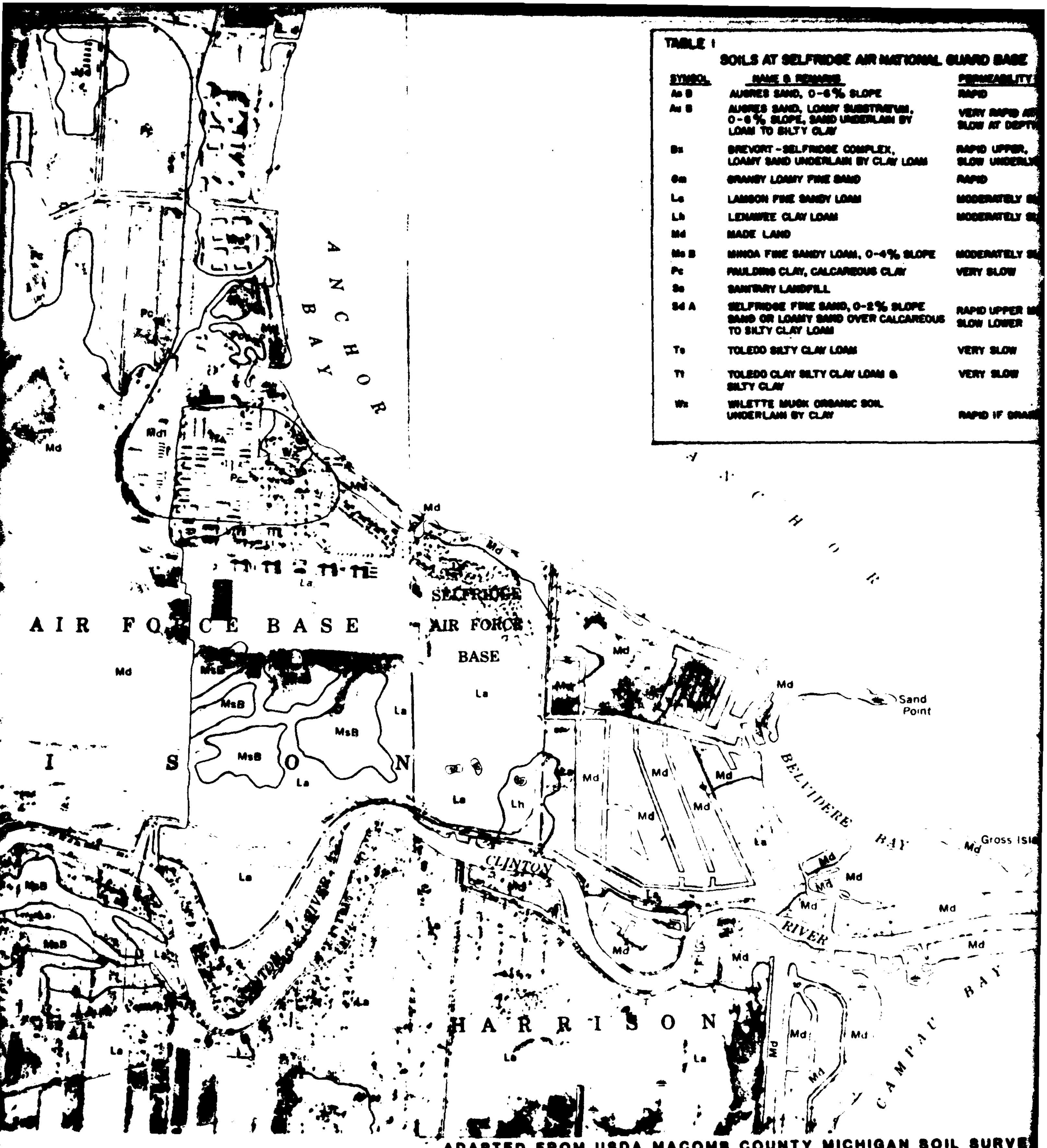


TABLE 1

SOILS AT SELFRIDGE AIR NATIONAL GUARD BASE

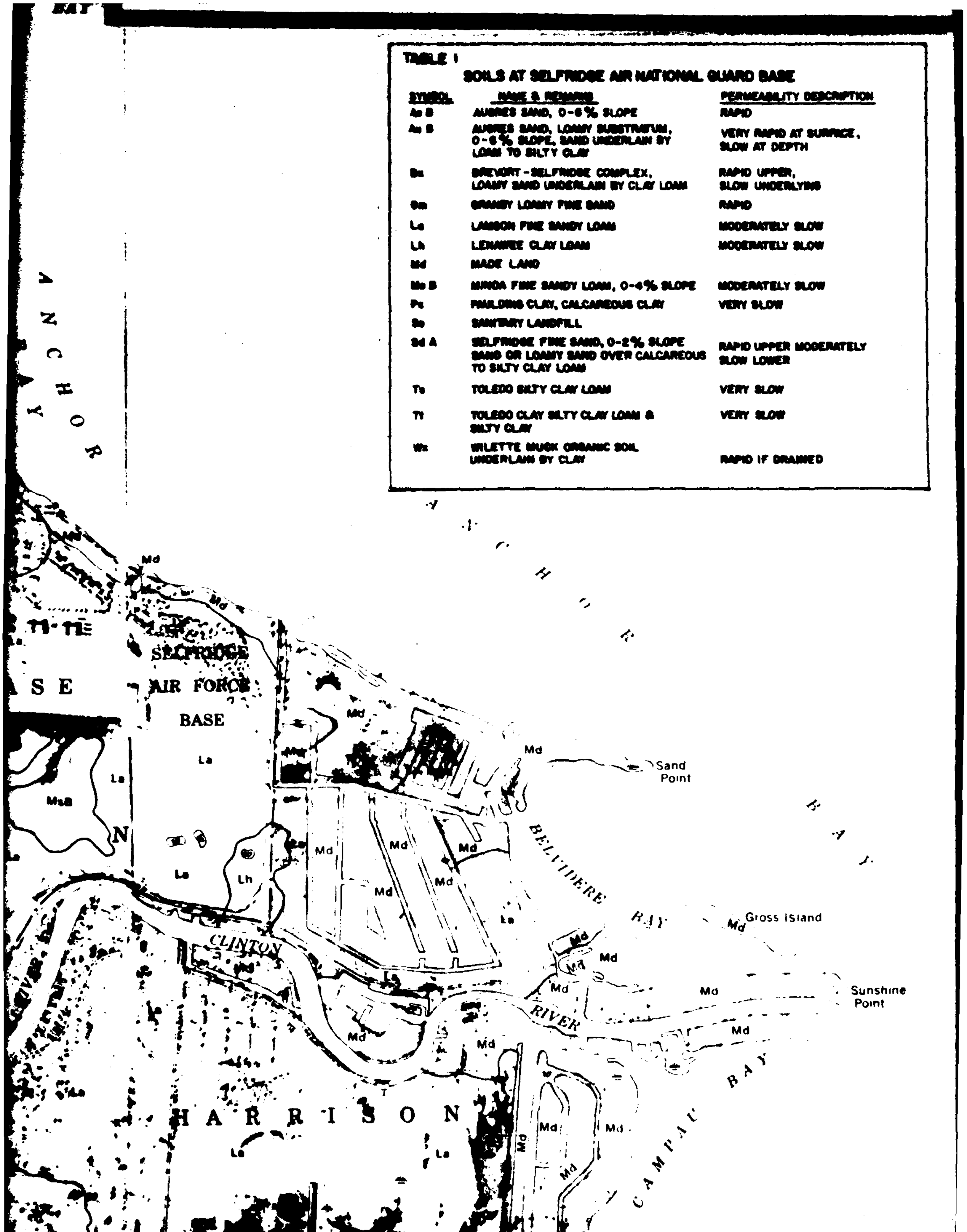
SYMBOL	NAME & REMARKS	PERMEABILITY
As B	AUGRES SAND, 0-6% SLOPE	RAPID
Au B	AUGRES SAND, LOAMY SUBSTRATUM, 0-6% SLOPE, SAND UNDERLAIN BY LOAM TO SILTY CLAY	VERY RAPID AT SLOW AT DEPTH
Bs	BREVORT-SELFRIDGE COMPLEX, LOAMY SAND UNDERLAIN BY CLAY LOAM	RAPID UPPER, SLOW UNDERLY
Gm	GRANBY LOAMY FINE SAND	RAPID
La	LAMSON FINE SANDY LOAM	MODERATELY S
Lh	LENAWEE CLAY LOAM	MODERATELY S
Md	MADE LAND	
Ms B	MINOA FINE SANDY LOAM, 0-4% SLOPE	MODERATELY S
Pc	PAULDING CLAY, CALCAREOUS CLAY	VERY SLOW
Sa	SANITARY LANDFILL	
Sd A	SELFRIDGE FINE SAND, 0-2% SLOPE SAND OR LOAMY SAND OVER CALCAREOUS TO SILTY CLAY LOAM	RAPID UPPER SLOW LOWER
Te	TOLEDO SILTY CLAY LOAM	VERY SLOW
Tl	TOLEDO CLAY SILTY CLAY LOAM & SILTY CLAY	VERY SLOW
Wx	WILLETTE MUCK ORGANIC SOIL UNDERLAIN BY CLAY	RAPID IF DRAI

ADAPTED FROM USDA MACOMB COUNTY MICHIGAN SOIL SURVEY

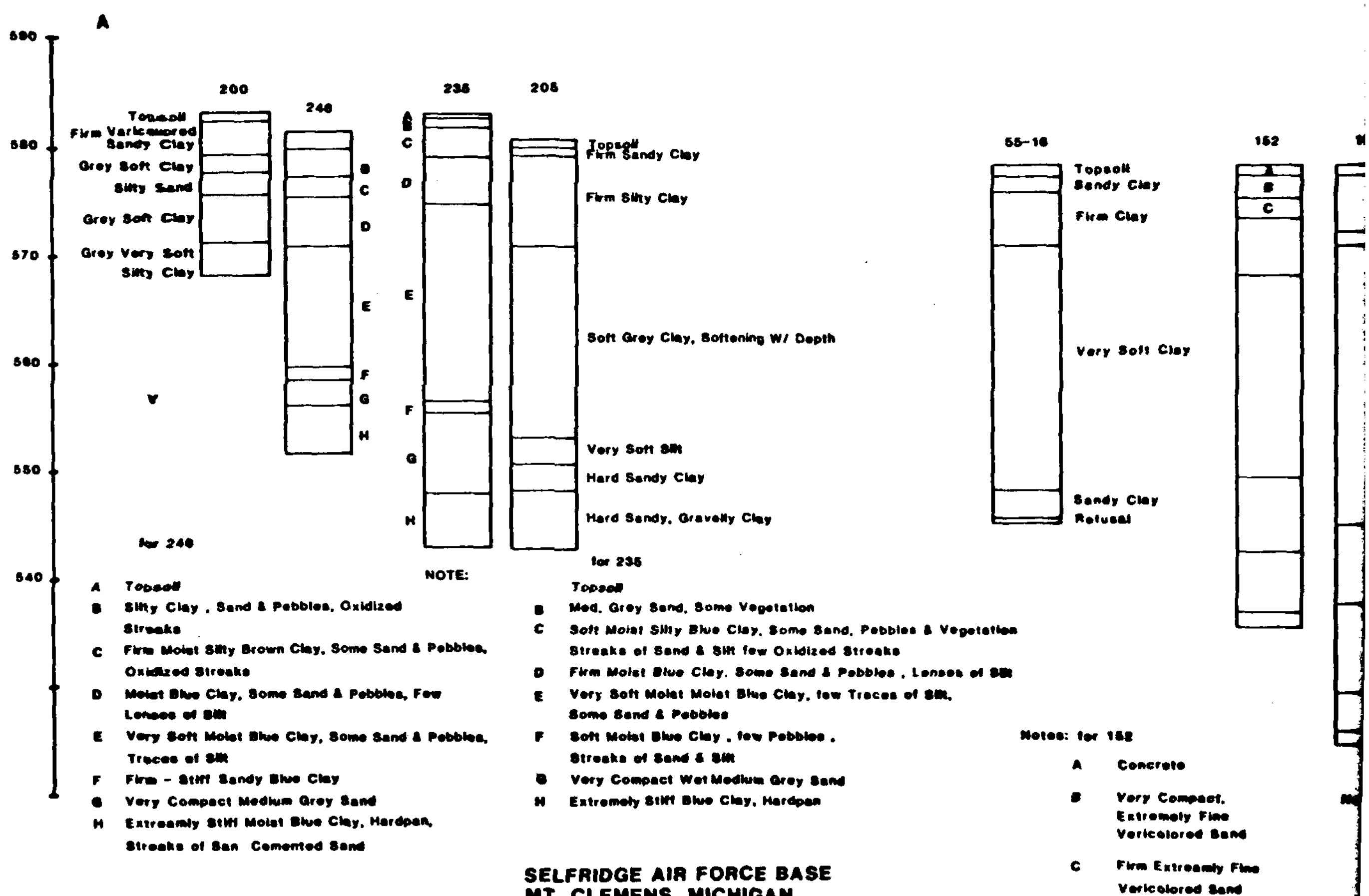
TABLE 1

SOILS AT SELFRIDGE AIR NATIONAL GUARD BASE

SYMBOL	NAME & REMARKS	PERMEABILITY DESCRIPTION
As B	AUGRES SAND, 0-6% SLOPE	RAPID
Au B	AUGRES SAND, LOAMY SUBSTRATUM, 0-6% SLOPE, SAND UNDERLAIN BY LOAM TO SILTY CLAY	VERY RAPID AT SURFACE, SLOW AT DEPTH
Bs	BREVORT-SELFRIDGE COMPLEX, LOAMY SAND UNDERLAIN BY CLAY LOAM	RAPID UPPER, SLOW UNDERLYING
Gm	GRANBY LOAMY FINE SAND	RAPID
La	LAMSON FINE SANDY LOAM	MODERATELY SLOW
Lh	LENAWEE CLAY LOAM	MODERATELY SLOW
Md	MADE LAND	
Ms B	MINOA FINE SANDY LOAM, 0-4% SLOPE	MODERATELY SLOW
Pc	PAULDING CLAY, CALCAREOUS CLAY	VERY SLOW
Sa	SANITARY LANDFILL	
Sd A	SELFRIDGE FINE SAND, 0-2% SLOPE SAND OR LOAMY SAND OVER CALCAREOUS TO SILTY CLAY LOAM	RAPID UPPER MODERATELY SLOW LOWER
Ts	TOLEDO SILTY CLAY LOAM	VERY SLOW
Tt	TOLEDO CLAY SILTY CLAY LOAM & SILTY CLAY	VERY SLOW
Wx	WILETTE MUCK ORGANIC SOIL UNDERLAIN BY CLAY	RAPID IF DRAINED



ADAPTED FROM USDA MACOMB COUNTY MICHIGAN SOIL SURVEY



SELFRIDGE AIR FORCE BASE
MT. CLEMENS, MICHIGAN
GENERALIZED LITHOLOGIC CROSS SECTION A-A'
HORIZONTAL SCALE = 1"=200'
VERTICAL SCALE 1"=10'

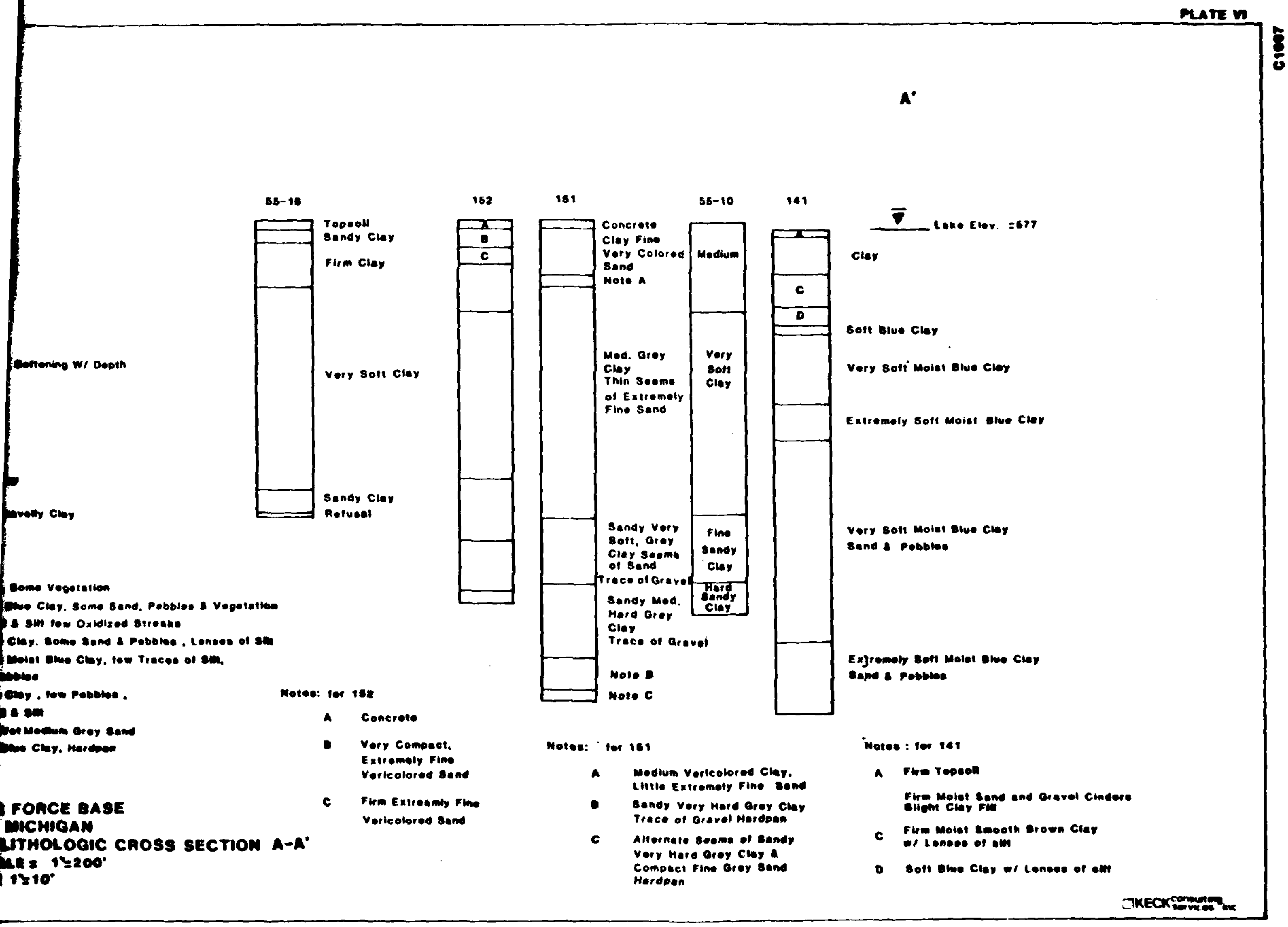
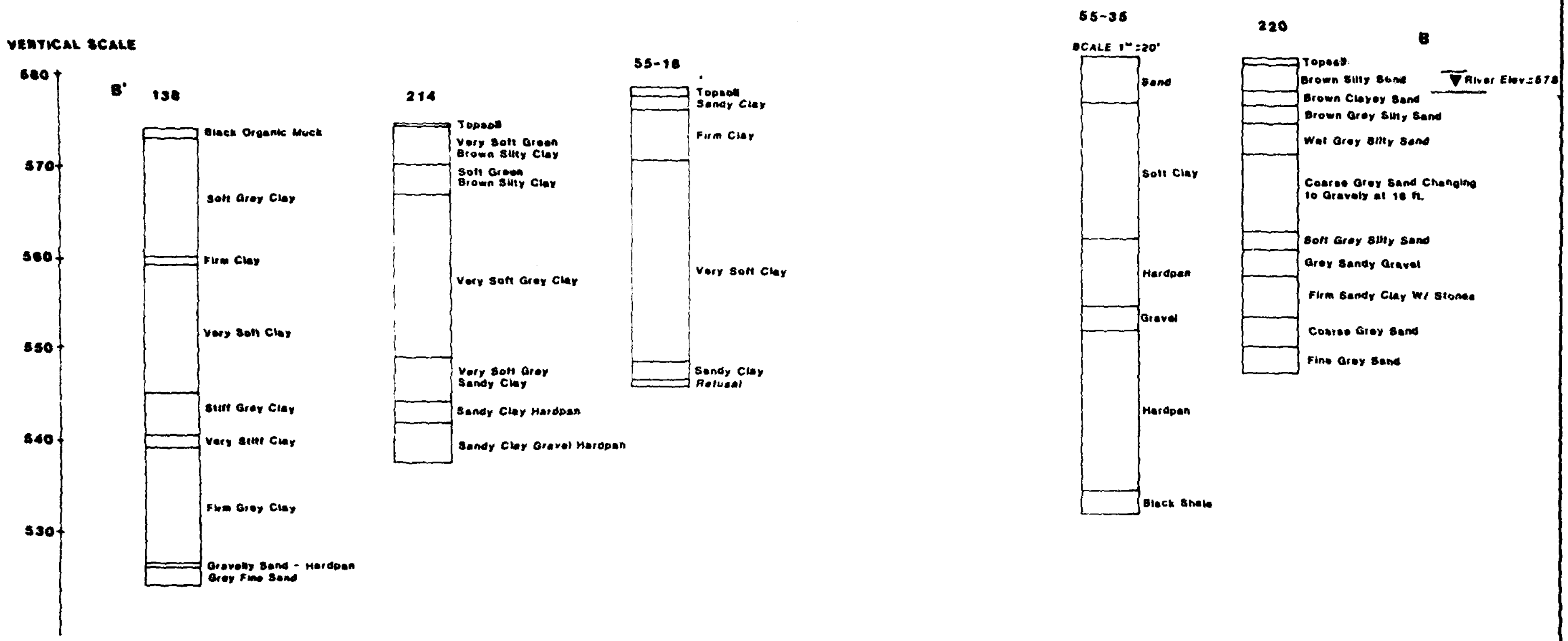


PLATE VI
C1097
A'
55-18
152
151
55-10
141
Lake Elev. ±677
Topsoil
Sandy Clay
Firm Clay
Very Soft Clay
Sandy Clay
Refusal
Concrete
Clay Fine
Very Colored
Sand
Note A
Med. Grey
Clay
Thin Seams
of Extremely
Fine Sand
Sandy Very
Soft, Grey
Clay Seams
of Sand
Trace of Gravel
Sandy Med.
Hard Grey
Clay
Trace of Gravel
Note B
Note C
Medium
Very
Soft
Clay
Fine
Sandy
Clay
Hard
Sandy
Clay
Clay
Soft Blue Clay
Very Soft Moist Blue Clay
Extremely Soft Moist Blue Clay
Very Soft Moist Blue Clay
Sand & Pebbles
Extremely Soft Moist Blue Clay
Sand & Pebbles
Softening W/ Depth
avelly Clay
Some Vegetation
Blue Clay, Some Sand, Pebbles & Vegetation
& Silt few Oxidized Streaks
Clay, Some Sand & Pebbles, Lenses of Silt
Moist Blue Clay, few Traces of Silt,
ebbles
Clay, few Pebbles,
& Silt
Wet Medium Grey Sand
Blue Clay, Hardpan
Notes: for 152
A Concrete
B Very Compact, Extremely Fine Vericolored Sand
C Firm Extreamly Fine Vericolored Sand
Notes: for 151
A Medium Vericolored Clay, Little Extremely Fine Sand
B Sandy Very Hard Grey Clay Trace of Gravel Hardpan
C Alternate Seams of Sandy Very Hard Grey Clay & Compact Fine Grey Sand Hardpan
Notes: for 141
A Firm Topsoil
Firm Moist Sand and Gravel Cinders Slight Clay Fill
C Firm Moist Smooth Brown Clay w/ Lenses of silt
D Soft Blue Clay w/ Lenses of silt
FORCE BASE
MICHIGAN
LITHOLOGIC CROSS SECTION A-A'
ALE: 1"=200'
1"=10'
KECK Consulting Services Inc

PLATE VII



SELFRIDGE AIR FORCE BASE

MT. CLEMENS, MICHIGAN

GENERALIZED LITHOLOGIC CROSS SECTION B - B'

HORIZONTAL SCALE 1"=10'

VERTICAL SCALE 1"=200' EXCEPT WHERE NOTED

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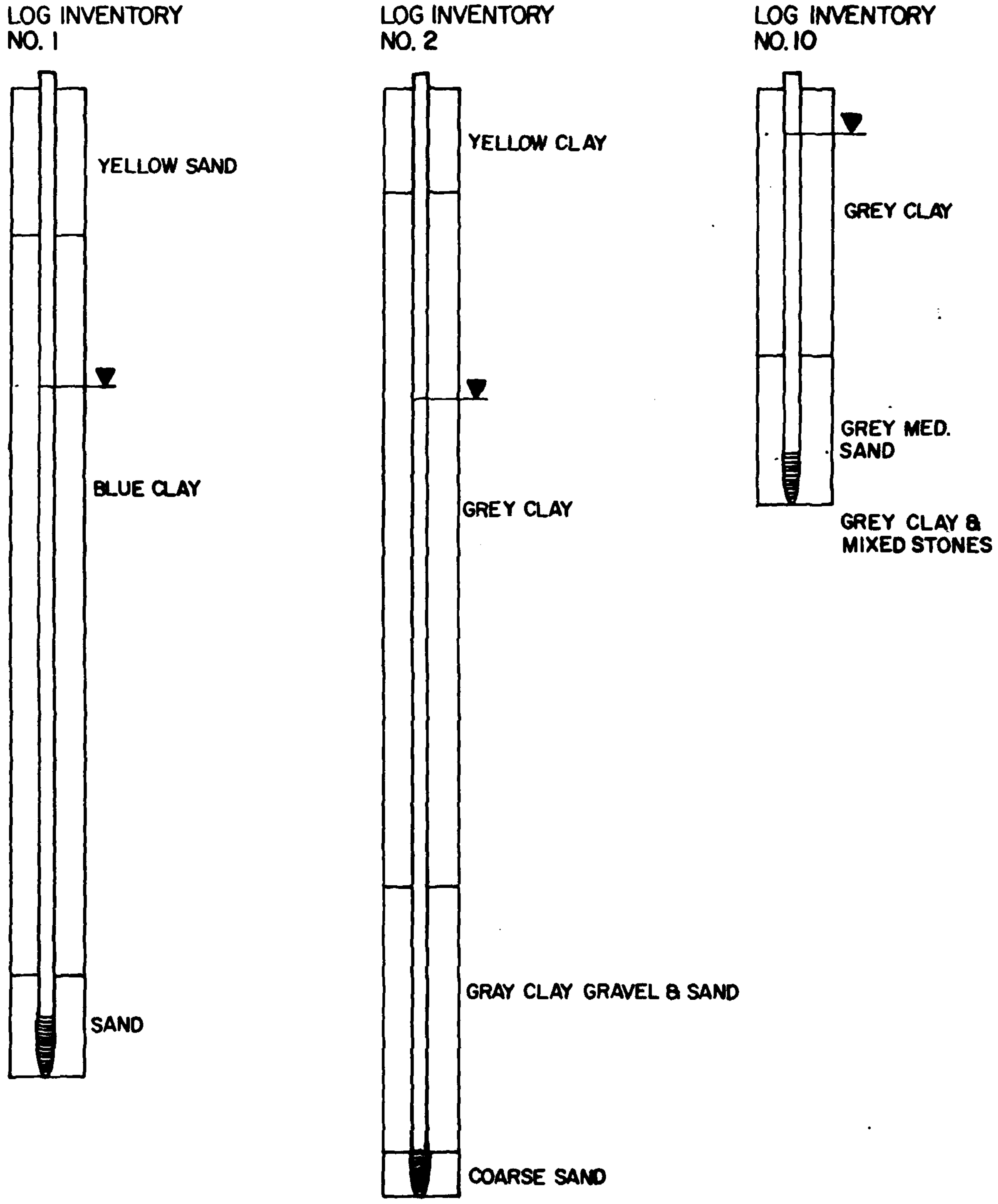
DRILLER'S LOGS OF TYPICAL DOMESTIC WELLS



KECK consulting services, inc.